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# MOTORSHIP

*Devoted to Commercial and Naval Motor Vessels*

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DIESEL MARINE ENGINES
FOR ALL CLASSES OF SHIPS

McINTOSH & SEYMOUR CORP.
AUBURN N.Y., U.S.A.

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*EXCLUSIVE technical and non-technical articles on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.*

# MOTORSHIP

*PROFUSELY illustrated with photograph c reproductions of the newest designs in international merchant motorship and Diesel-engine construction and auxiliary equipment.*

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Vol. VII — New York, U. S. A., December, 1922 — No. 12

(Cable Address—Freemote, New York)

# Western Union Co.'s Cable Ship

## *New Designs for Diesel-Electric Propelled Vessel Issued to Shipyards*

BIDS have been asked from American and British shipbuilders by the Western Union Telegraph Company on another Diesel-electric driven cable laying and repair ship to be built to Lloyd's new classifications, and will be the first ship thus constructed in this country. Alternate bids have also been requested for steam propulsion. This is not the same vessel as originally specified, but is of new design. It will be remembered that the cost of the first vessel was considered prohibitive. The new ship has twin screws, Diesel-electric drive and has the following dimensions:

Length ..... 211′
Breadth m.d..... 34′
Depth to U. D..... 18′ 6″
Power at propeller..... 1,000 shaft h.p.
Designers — J. W. Millard & Bro., New York City.

The hull will be of steel construction on the cellular-bottom system, with intercostal side girders and with floor plates lightened with manholes fitted to every frame. Fuel-oil will also be carried in deep cross-bunkers at the forward end of the engine-room, the space being subdivided by steel bulkheads.

In addition to the regular life-boats, there will be one 18′ 10 h.p. motor-launch, while one of the Class A life-boats will also be motor-driven. There will be an 18″ Sperry or other approved type searchlight mounted at each end of the flying bridge. There also will be a Sperry gyro-compass. The steering-gear will be hydro-electric type of Hastie or other approved make.

For the main power plant McIntosh & Seymour, Worthington, Nelseco or other approved makes of Diesel engines have been specified. The entire equipment, together with electrical generators, motors and auxiliaries, will be considered as a complete unit. There will be two 6-cylinder Diesel engines, right and left-handed, respectively, each directly connected to a double-unit main electric generator. Each generating double-unit consists of two 205 k.w. 250 volt electric generators turning at 200 to 225 r.p.m., according to the design of Diesel engine. Each main propulsion unit will deliver 410 k.w. at 250 volts direct current. These generating sets will supply current for two 500 shaft h.p. 500-volt direct-current propelling motors turning at 150 r.p.m., giving this twin-screw vessel a total of 1,000 shaft h.p.

For auxiliary purposes there will be two Diesel-driven 75 k.w. 250 volt D.C. compound generating-sets. There also will be a 220 k.w. 115 volt D.C. generating-set for lighting purposes. The Diesel engines for both main and auxiliaries will be of the single-acting non-reversible type, and the cylinders of the main engines will have detachable cylinder liners, while the valves are to be mounted in removable cast-iron cages.

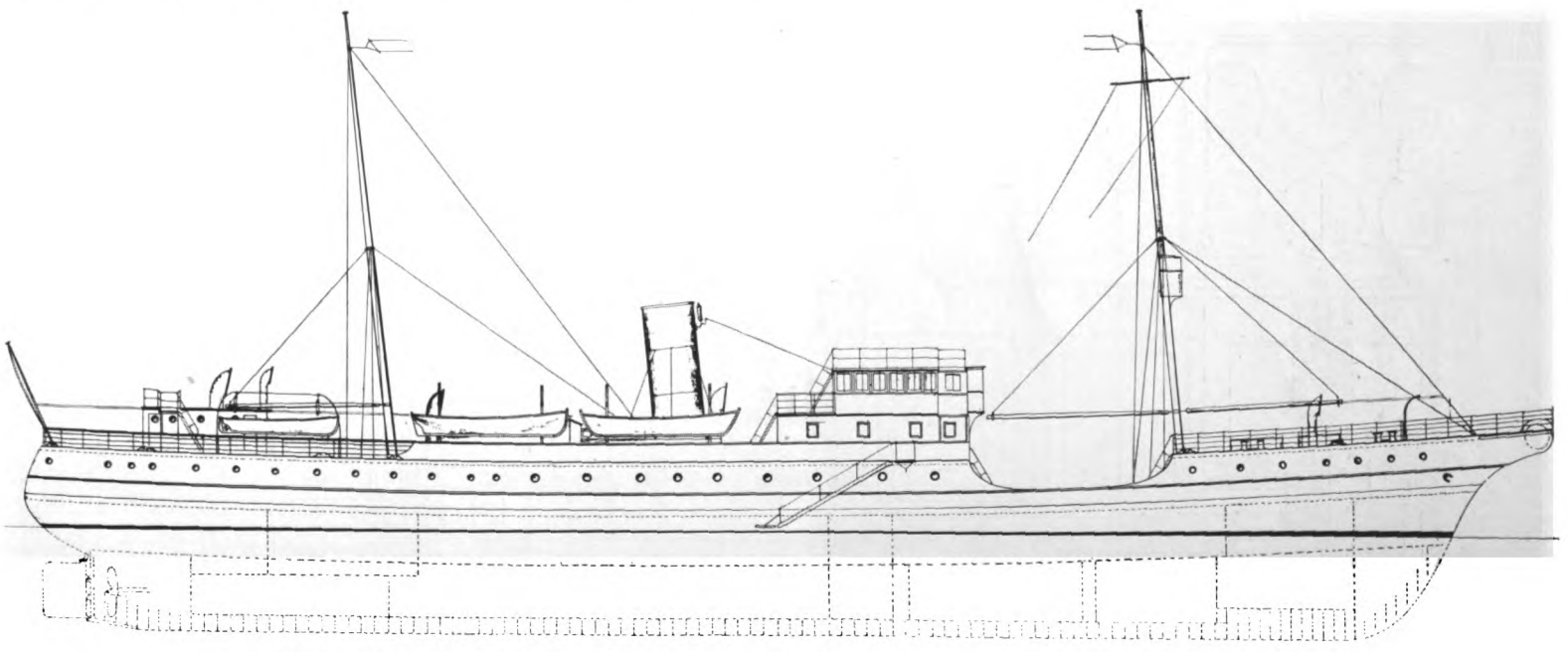
An overload capacity of at least 20 per cent for one hour is to be guaranteed. A series of shop tests will be carried out on the Diesel engines before installation, as follows:

(a) 24 hours non-stop at rated b.h.p. and r.p.m.
(b) 1 hour run at rated revolutions, but at 20 per cent overload.
(c) 2 hours' run at rated r.p.m. at three-quarters load.
(d) 2 hours at rated r.p.m. and at half load.
(e) 2 hours at rated r.p.m. and quarter load.
(f) With the engine running at rated revolutions at full load, the load will be suddenly removed and the speed variations of the engines measured.

Full-load fuel-consumption,, based on fuel-oil of 18,500 b.t.u., is not to exceed 0.42 lb. per b.h.p. hour, while the auxiliary engines, using the same fuel, must not exceed 0.46 lb. per b.h.p. hour.

The electrical apparatus for the propelling machinery is to be either Westinghouse, General Electric, or other approved makes; but the entire apparatus, including the main generators, auxiliary generators, control equipment and switching devices, switchboards, instruments, cables, etc., are to be supplied by one manufacturer.

Among the auxiliary machinery are the various pumps, a Brunswick-Kroeschell ice machine, a Paracoil distilling apparatus, donkey-boiler with its pumps, condenser and equipment, electric-winches, steering gear and windlass. For the thrust-shafts, which will be of 8½″ diameter, Kingsbury bearings will be used. The two propellers will be of three-bladed manganese bronze 8′ 6″ in diameter. Engine-room pumps are to be of the Worthington, Gould or Kinney make. For all fuel-oil tanks there will be Pneumercator indicator gauges. There will be a workshop for the engineers fitted with a 6″ lathe, vertical drill, emery grinders, etc. Through the courtesy of J. W. Millard & Bro., naval-architects to the owners, we are enabled to reproduce a profile plan of the vessel.



**Outboard Profile Plan of the Western Union Telegraph Co.'s proposed Diesel-electric cable ship**

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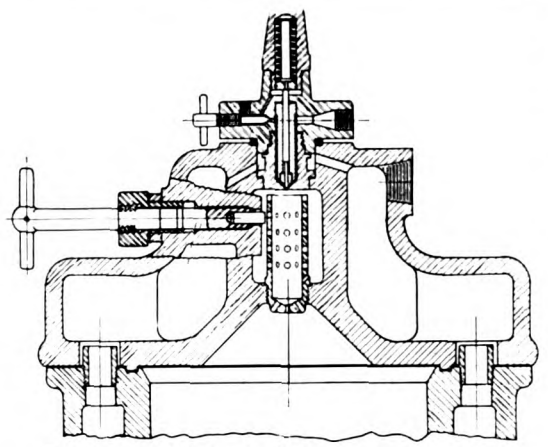
# Trout Airless-Injection Heavy-Oil Engine

***Well-known Steam-Engine and Propeller Building Company Produces New Internal-Combustion Motor Ranging from 50 to 480 b.h.p. in Sizes***

WHEN designing an oil engine for workboat propulsion, simplicity of operation, overhaul and adjustment is an essential key-note, because for every half-dozen engines that fall into skilled hands a dozen will be in charge of men who have but a smattering of mechanics. It is hard to convince a fisherman or other small commercial boat-owner accustomed to "running a gasolene kicker" that it is economy to hire trained men to operate an oil engine costing anything from $2,000 to $20,000. For the engine manufacturer to force this point may often mean the loss of a sale. Consequently, the best available alternative has to be adopted, even if there is a slight loss from the fuel efficiency of the true Diesel cycle. This alternative is to construct an oil engine in as simple a form as is possible and to combine such with ruggedness. In this way an engine can be turned out at low cost, which serves the dual purpose of meeting the first-cost figure that will loosen the purse strings of fishermen and others who depend upon workboats for their daily bread, and of providing them with a piece of machinery which will enable them to devote most of their time at sea to the main object instead of having to be in constant attendance on the power plant.

Many manufacturers after a careful study of the situation have decided that a certain amount of simplicity can be attained by modifying the true Diesel cycle to the extent of dispensing with the high-pressure compressor and the fuel injection by air system with its companion air bottles, and adopting some form of airless injection of fuel. Such a decision was reached by the H. G. Trout Company, of Buffalo, N. Y., when they decided to construct heavy oil engines in addition to their well-known lines of steam engines, propellers, etc.

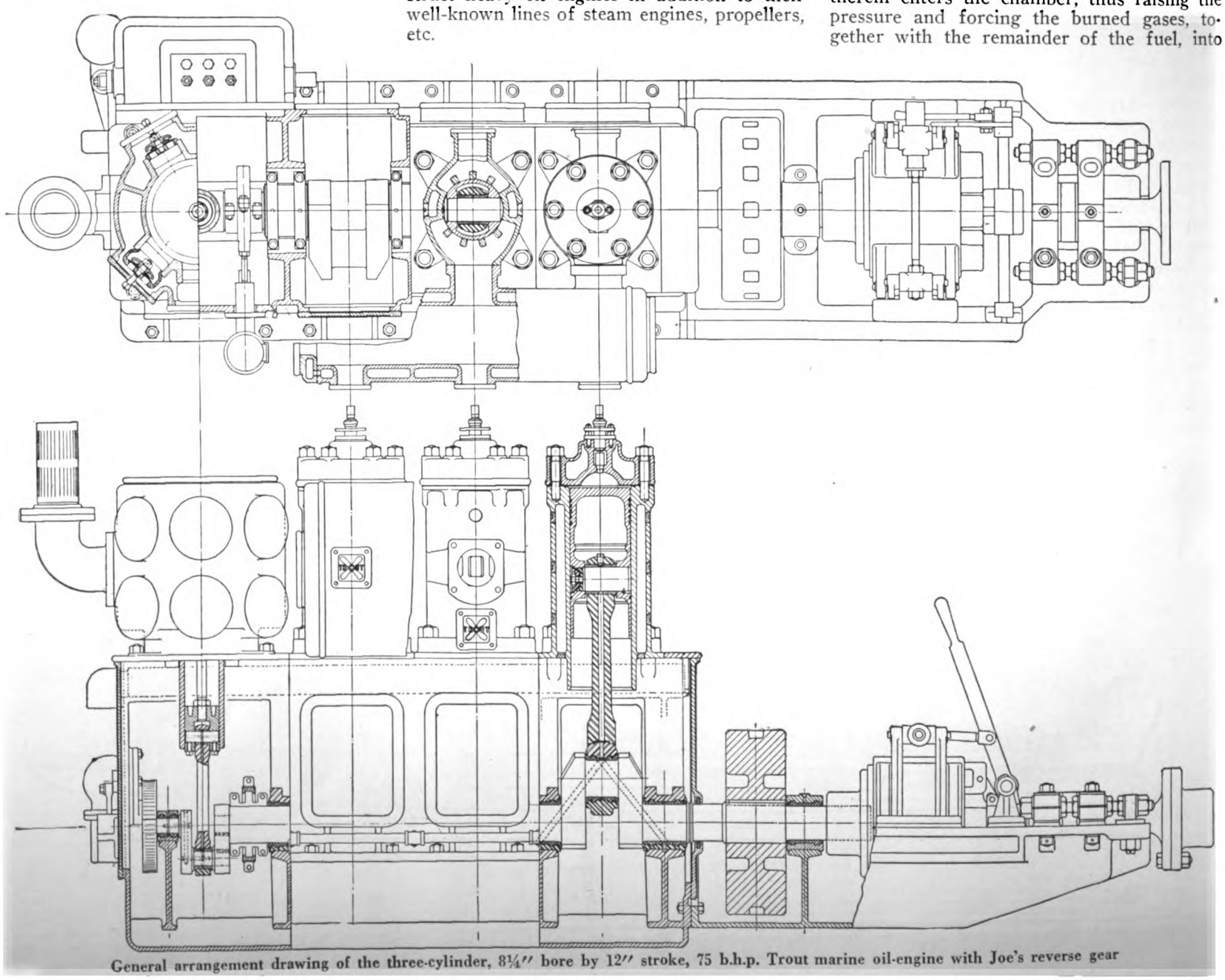


**Section of cylinder head showing combustion chamber**

The Leissner system of injection and combustion appealed to them as allowing a very simple form of engine design, so they adopted it. The sectional drawing of the cylinder head shows this arrangement. On the upstroke of the working piston, atmospheric air is compressed in the cone-shaped main combustion chamber and in the small chamber above, through which a perforated tube runs, to nearly 500 pounds pressure. This compression generates sufficient heat to ignite the fuel when the engine is warm.

However, the oil is not sprayed into the main combustion chamber as with the true Diesel engine; but when the piston, or rather the crank, is about 20 degrees from the top dead-center the fuel pump commences its effective stroke and builds up an oil pressure of nearly 2,000 pounds under the shoulder of the fuel valve. The latter is shown directly over the tube with its nozzle almost leading into it.

By the time dead-center is nearly reached the accumulating fuel pressure lifts the valve against the "holding down" spring and fuel is automatically forced into the combustion tube, where it is ignited by the heat. But the air in the tube is insufficient to combust more than a small part of the oil. However, expansion of the burning oil forces some of the fuel in its vapor form through the holes into the small chamber surrounding the tube. But only a sufficient quantity to use up the air therein enters the chamber, thus raising the pressure and forcing the burned gases, together with the remainder of the fuel, into



**General arrangement drawing of the three-cylinder, 8¼″ bore by 12″ stroke, 75 b.h.p. Trout marine oil-engine with Joe's reverse gear**

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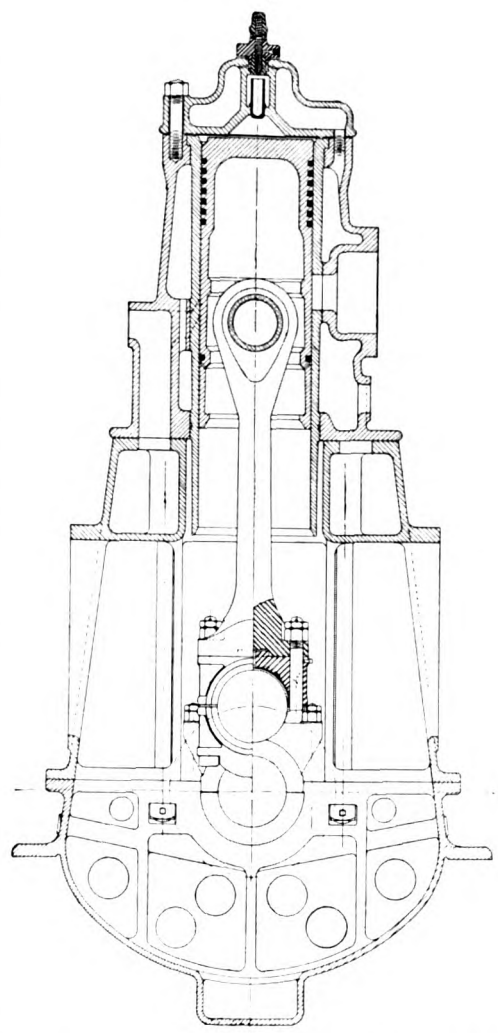
the main combustion chamber just as the piston crosses top-center. Here it mixes with the main charge of hot air and completes combustion.

Successful manufacture and operation of this system rests with careful design of the little pre-combustion chamber and the orifices in the tube. The holes are so proportioned that the time required for the fuel to go through the various stages in the tube and in the pre-combustion chamber, also to pass into the cylinder, is sufficient to give a flat-topped constant-pressure indicator-card almost identical to the air-injection Diesel engine.

On the left side of the drawing of the cylinder head can be seen a screwed plug. This plug holds a treated paper or punk wad, which will glow when lighted with a match. By its use rapid starting of a cold engine can be effected, which reduces the quantity of starting air required to a minimum. Also the plug can be used for compression relief when turning over by hand. While the plug is fitted to all small engines, its use is optional on large sizes.

Having described the general operating principle, we will turn to the constructional features of the Trout engine. It is of the two-cycle port-scavenging type with the scavenge pump arranged with crankshaft drive at the forward end, step-piston or crankcase compression not being considered so efficient for the purpose by the Trout designers, although a little larger overall length results; also the separate scavenge-pump means low lubricating oil consumption. Reference to the cross section will show a small horizontal chamber in the upper part of the crank housing. This forms a receiver for the scavenge air, which enters the cylinder at low pressure for the purpose of charging the same with fresh air when the products of combustion are passing out at the ports under their own pressure.



Section of the two larger models of the Trout marine oil-engine. These are directly reversible

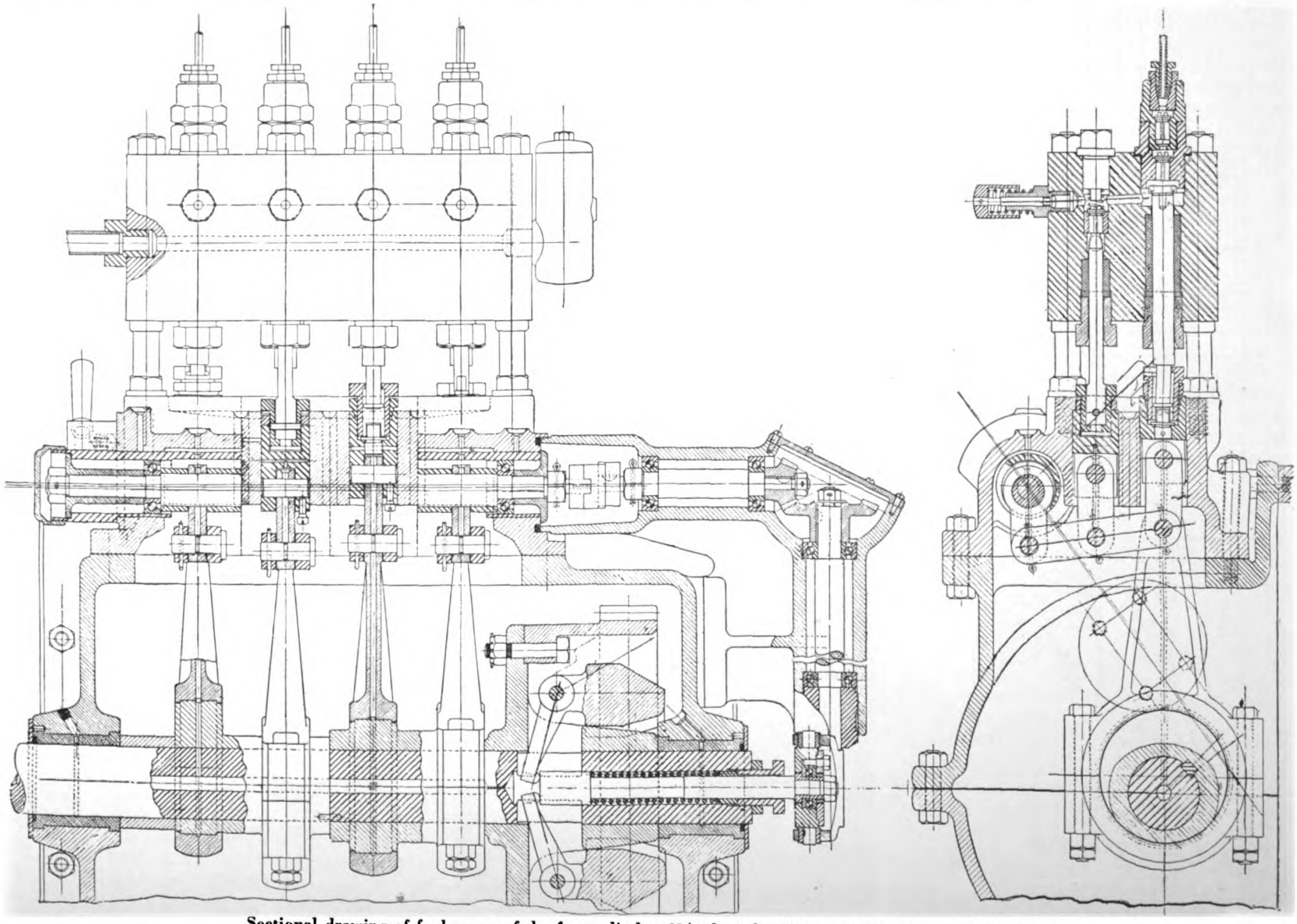
There are nine powers of Trout engines in three different cylinder sizes as follows:

| *Cyl. Bore and Piston Stroke* | *No. of Cyl.* | *Engine Speed* | *Brake Horse-Power* | *Rating M.E.P.* | *Method of Reversing* |
|---|---|---|---|---|---|
| 8¼″x12″ | 3 | 350 R.P.M. | 75 | 44 lbs. | Joes gear |
| 8¼″x12″ | 4 | 350 R.P.M. | 100 | 44. lbs. | Joes gear |
| 8¼″x12″ | 6 | 350 R.P.M. | 150 | 44 lbs. | Joes gear |
| 11½″x18″ | 3 | 250 R.P.M. | 150 | 42.5 lbs. | Direct Reversible |
| 11½″x18″ | 4 | 250 R.P.M. | 200 | 42.5 lbs. | Direct Reversible |
| 11½″x18″ | 6 | 250 R.P.M. | 300 | 42.5 lbs. | Direct Reversible |
| 14¼″x21″ | 3 | 220 R.P.M. | 240 | 43 lbs. | Direct Reversible |
| 14¼″x21″ | 4 | 220 R.P.M. | 320 | 43 lbs. | Direct Reversible |
| 14¼″x21″ | 6 | 220 R.P.M. | 480 | 43 lbs. | Direct Reversible |

From the above range of sizes it will be realized that almost every class of workboat and yacht is covered, and several powers can be obtained at different propeller speeds. For instance, the six-cylinder 150 b.h.p. engine at 350 R.P.M. probably will be best for a motor yacht where quiet running and freedom from vibration are essentials, while the three-cylinder 150 b.h.p. engine at 250 R.P.M. is better for a workboat because low engine and low propeller revolutions have greater importance for obvious reasons.

In the three smallest engines a Joe's mechanical reverse gear has been adopted, but all the larger models are directly reversible by compressed air. The latter also have Kingsbury thrust bearings. Because of the larger and heavier parts to be handled when overhauling, the engine frame is in two side pieces mounted on the bed plate. This differs from the smaller engines with which the frame and bed plate are in one casting. Either side piece can be removed by taking out the through bolts holding the cylinders to the frame and bed plate and shoring up the cylinders. This makes easy the lifting out of the crankshaft.

Attention to the details of the entire engine design is emphasized in the construction of



Sectional drawing of fuel pump of the four-cylinder, 8¼″ bore by 12″ stroke, Trout marine oil-engine

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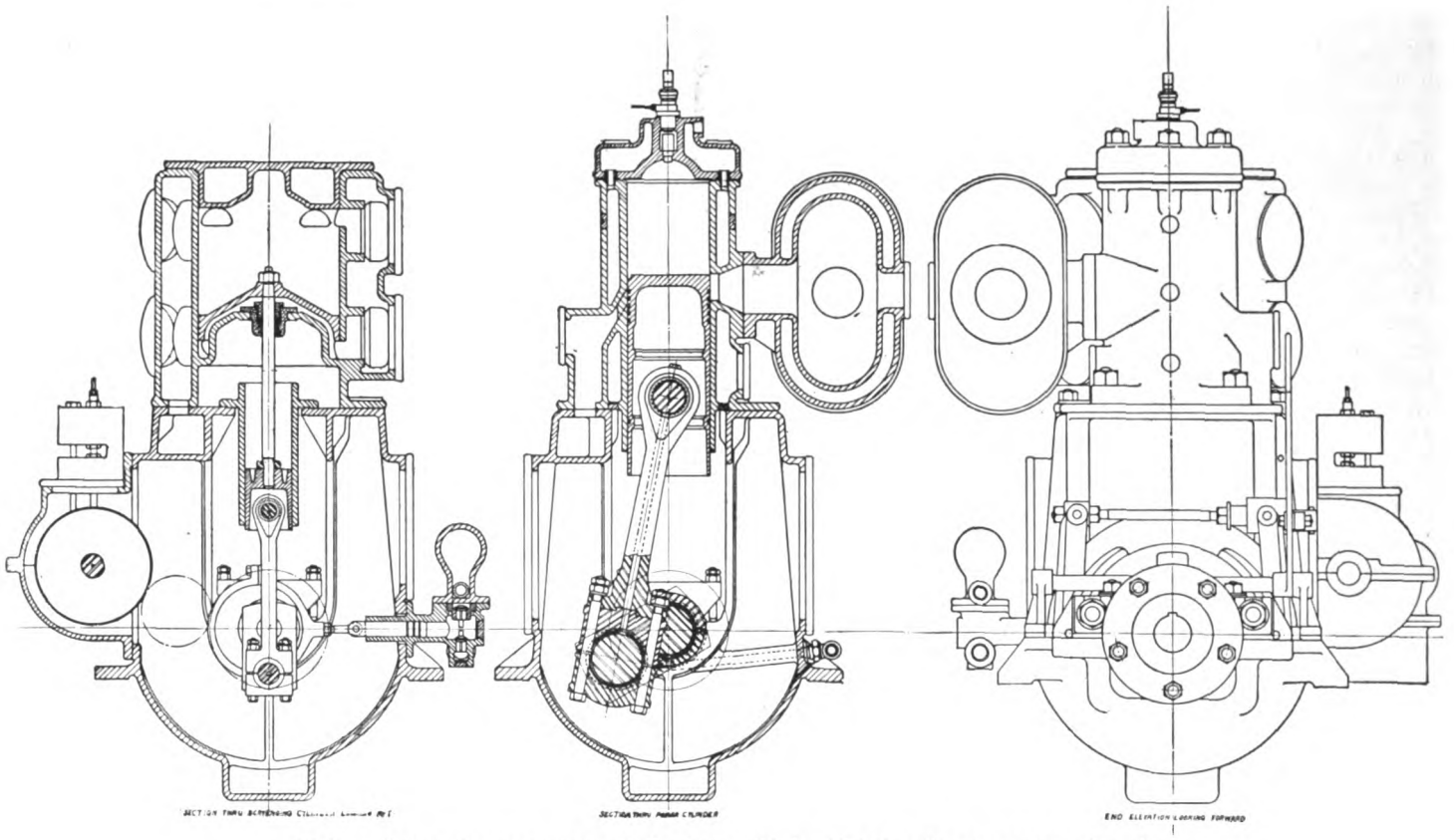
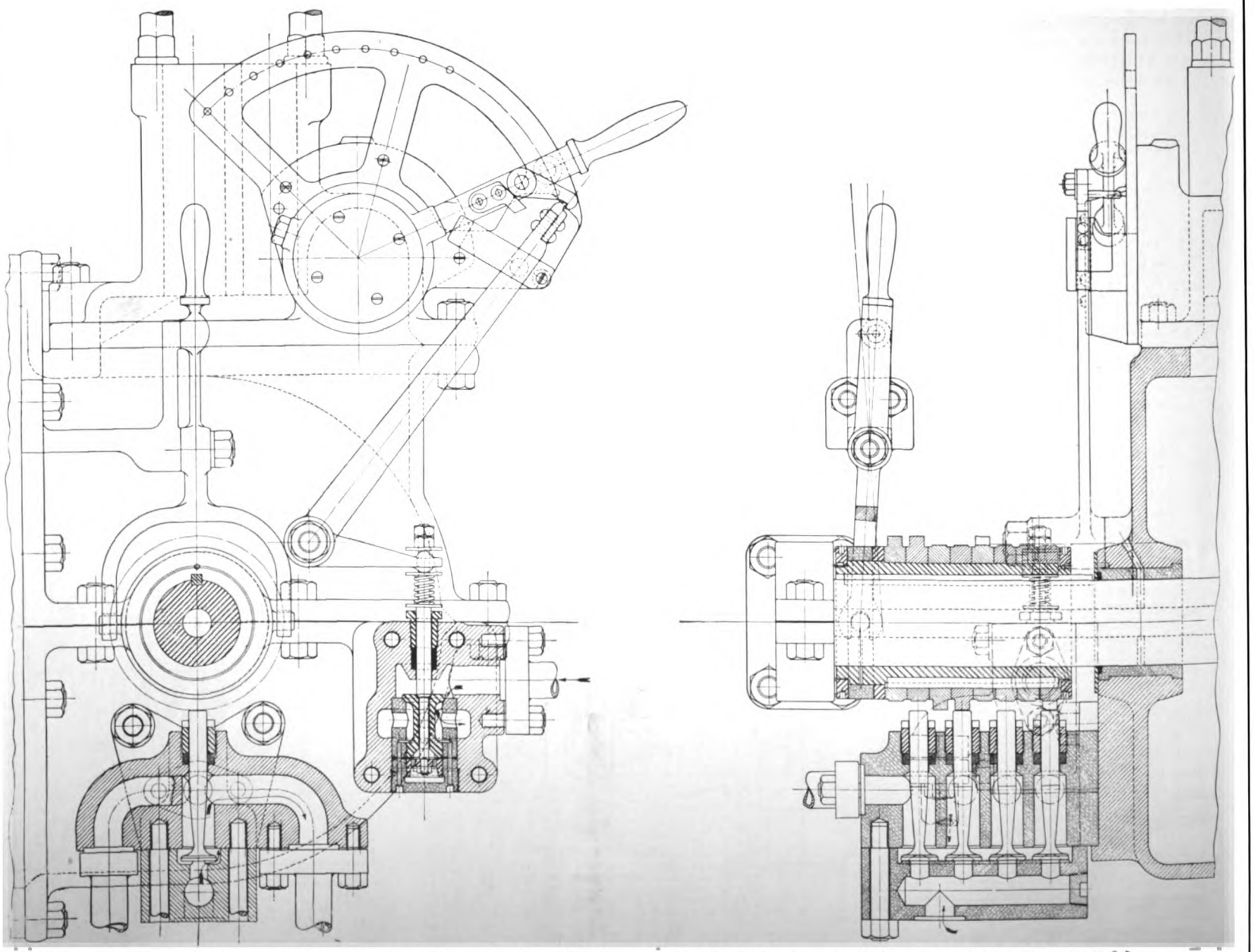


End sections and arrangement of the three-cylinder 75 b.h.p. Trout marine oil-engine



Control gear of the larger sizes of Trout marine oil-engines, namely the 11½″ bore by 18″ stroke and 14¼″ x 21″ models

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the fuel pump, of which we give a sectional drawing. There is a separate pump for each cylinder, the pumps having eccentric drive with double-eccentric controlled fulcrum for the trip lever. A hand lever regulates one eccentricity and the governor controls the other eccentric movement. Thus with the hand control at " full load " position the governor can completely cut out the fuel and so prevent propeller racing.

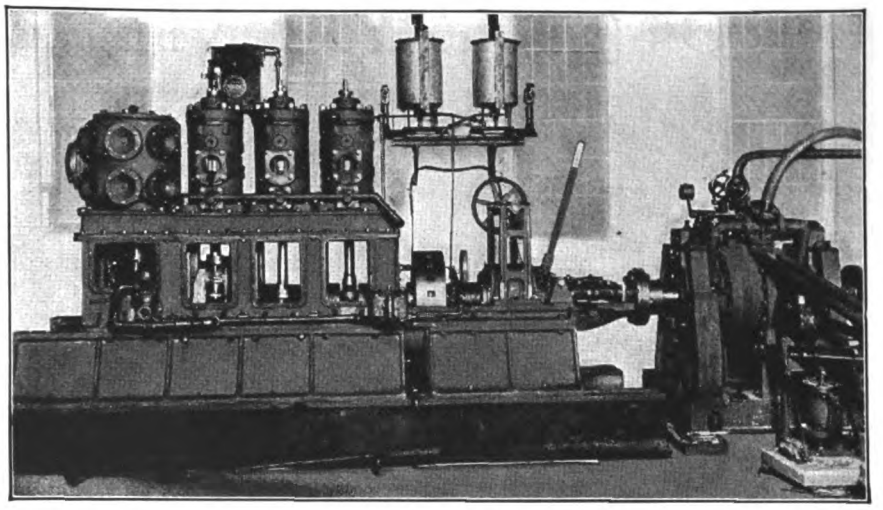
Details of this control have not a little interest. The trip-lever fulcrum is so located that the trip will hit the suction valve, opening it against the pump pressure at any desired or pre-determined point in the stroke of the pump plunger. How sensitive is the regulation will be understood when we mention that the stroke of the pump plunger of the 8¼-inch x 12-inch engine is 1/16 of an inch.

The plunger is pulled down from the top of the stroke by an adjustment catch until it approaches the termination of the downward stroke. It then rests on the stop until a tappit hits it. This tappit and catch are connected to the crosshead of the eccentric strap of the pump. In order to fill the fuel lines to each cylinder before starting the engine, a hand primer is fitted. The foregoing description applies particularly to the non-reversing models.

With the direct-reversing engines the controlling mechanism is confined to a single motion of each of the two levers. When the fuel lever is in the neutral position a dog engages the air-starting lever. To start the engine the air lever is pushed forward through a few degrees of its arc of travel. This action raises the stem of a pilot valve that opens the pressure equalizer, forming part of the stem, and air pressure gets under the main valve, assisting the operator to open it as he moves the control lever a little further forward.

When this valve is open the compressed air is permitted to flow to a set of distributing valves, one for each cylinder, and all are closed by the pressure excepting one held open by its cam. From these valves the air passes to the corresponding cylinder via a check valve in the cylinder head and forces down the working piston, turning over the engine. As the engine picks up speed on the air pressure the control lever is pushed further over, the dog is tripped and the starting-air lever is released, a spring causing it to return to its original position and simultaneously closing the pilot valve. Fuel then is injected and the engine picks up under load. As the pilot valve closes it uncovers an outlet to the atmosphere causing the pressure under the distributing valves to drop. The valves stay on their seats, but open with a single revolution of the camshaft.

To reverse the engine, the third lever shown in the drawing of the control gear is thrown in the opposite direction, shifting the sleeve of the starting cam along its shaft and brings another set of cams over the distributing valve stems. Then the fuel-control lever is brought to the neutral position and pushed forward. The engine starts as before, but in the reverse direction. In cold print this mechanism may appear to be somewhat complicated, but in reality it is very simple and the complete cycle of manoeuvring actions takes but a few seconds.



**The new Trout marine oil-engine**

## OIL ENGINES IN THE YACHTING WORLD

WHEN Henry W. Putnam's auxiliary Diesel-yacht ALCYONE leaves for a southern cruise this winter, she will present quite a different appearance from the illustration on page 358 of our May issue. Tams & King, her designers, have prepared alteration designs and specifications and have superintended the work at the Tebo Yard of the Todd Shipyards Corp., in Brooklyn, N. Y. The work consists of removing the mainmast, reducing the height of the foremast and mizzenmast and adding a stack for exhausts amidships. Therefore, it will be noted that she will generally resemble the steam-yacht type in appearance. Her speed will be increased by reason of reduced windage of lofty sails and spars. She has two six-cylinder 225 b.h.p. Winton Diesel engines, each driving 140 K.W. Westinghouse generators, these furnishing power to a 350 b.h.p. electric propelling-motor.

During the past season's yachting, the auxiliary Diesel-electric three-masted schooner yacht GUINEVERE, owned by Edgar Palmer, has performed in a creditable manner. She has never failed to be ready for a trip whenever her owner desired. Slight adjustments have been made which have improved her operation in actual service over her trial performance. Her Winton-Westinghouse Diesel-electric installation has propelled her 4,207 miles in the 110 days in which she was in commission.

The Winton Diesel-yacht EDYTHE, built for John F. Craig, President of the Long Beach Shipbuilding Co., of Long Beach, California, has been purchased by George Whittell, Jr., of San Francisco. The price is reported to be $100,000.

Early last summer the SABALO, owned by Van Lear Black went into commission after being converted from gasoline to oil-engine power. In place of three gasoline-engines of 220 h.p. each two 225 h. p. Winton Diesel-engines were installed. She is 140 ft. by 19 ft. 6 in. by 7 ft. This splendid yacht is of steel construction, nicely modeled both for speed and seaworthiness and often makes the run from Baltimore to New York by the outside route, up the coast, leaving Baltimore in the evening and arriving at New York by morning.

As a result of the season's operation we are now able to report that she saves an average of $400 per round trip as compared with the cost of gasoline for the former engines, which were perfectly satisfactory except that they were more expensive to operate than the new heavy-oil engines. With the two wing gasoline engines turning 48 in. by 50 in. three-blade bronze propellers at 350-450 revs. per min. the SABALO averaged slightly better than 11 knots. With the installation of the two six-cylinder 225 h.p. Winton Diesel-engines and auxiliaries approximately 25 tons was added to the displacement; yet with only 10 h.p. more a speed of better than 12 knots is attained. This is partly accounted for by the fact that these new engines operate larger and more efficient propellers, being 54 in. by 66 in. of the 3-blade Columbian bronze type turning at 250-260 r.p.m.

**Launch of the yacht "Goodwill"**

When the SABALO was hauled out in the Fall of 1921 at Robert Jacob's yard, City Island, New York, she was put in the hands of Tams & King, naval architects of New York. Arthur B. Raymond of their staff immediately entered into a detailed scientific study of the strength and stresses of her structure with the object of determining exactly where and how she would need stiffening to accommodate this added weight of power plant. The necessary strengthening was made, with the result that she now makes greater speed than previously without vibration or other effects of installing heavy Diesel-engines in place of lighter, faster-running gasoline-engines.

The auxiliary steel schooner yacht GOODWILL, which is being built for Mr. Keith Spalding of Chicago by the Bethlehem Shipbuilding Corporation, Ltd., was launched Saturday, October 21st, at the Harlan Plant, Wilmington, Del. The yacht, which was designed by Henry J. Gielow of New York, is a two-masted schooner measuring 161 feet over all with a beam of 30 feet, a depth of hold of 21 feet, and a draft of 15 feet 3 inches. The auxiliary propelling machinery will consist of a six-cylinder Nelseco Diesel-engine. It is expected that the yacht will be completed and turned over to her owner by the first of the year.

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# Oil-Engine Power in the Frozen North

***Fairbanks Morse Engine in MacMillan's Arctic Ship "Bowdoin," Drives Her Into Waters Never Before Sailed by Man***

THE daily press has given many fascinating accounts of Dr. Donald B. MacMillan's scientific exploration voyage to the Arctic regions, whence he recently returned; but few newspapers did more than just refer to the power installation of his vessel, the BOWDOIN, which contributed a goodly share in the success of the journey, as it has in several other polar expeditions, including two of Amundsen's. According to Commander Frank Wild, who succeeded Sir Ernest Shackleton, the QUEST would have had her steam plant replaced by an oil-engine were it not for the shipworkers' strike in Great Britain occurring at a critical juncture. The BOWDOIN is powered with a Fairbanks Morse engine. The selection of an oil-engine for a hazardous voyage into the frozen North is a fine tribute of faith in the reliability and suitability of this type of power. Reading Dr. MacMillan's account of those fourteen months "at the top of the world" one cannot be otherwise than impressed with the dangers of navigating ice-infested waters on a coast almost entirely devoid of means of human habitation and completely lacking means of assistance in the event of trouble. Vessels entering this waste of ice and snow must rely entirely upon their own resources, as much of the territory which was entered has never before been visited by white men. Certainly no words could more completely endorse the oil-engine than those of Dr. MacMillan when he said "the engine was absolutely perfect throughout the 5,000-mile Arctic cruise."

His vessel was a trim knockabout-schooner of 15 net tons, built of wood for the voyage by Hodgdon Brothers, of East Boothbay, Maine, from designs by William H. Hand, Jr., of New Bedford, Mass. Due to many years spent battling with Arctic conditions, Dr. MacMillan was able to designate the essential details of his vessel, which were ably incorporated by both designer and builder. The BOWDOIN is of the following dimensions:

| | |
|---|---|
| Length (o.a) | 87′ 1″ |
| Breadth (m.d) | 21′ 0″ |
| Draft | 10′ 6″ |
| Rig | Schooner |
| Auxiliary Power | 45 h.p. |

At this point it might be well to quote Dr. MacMillan on the requirements of a ship for Arctic exploration, for many may feel that she is somewhat small for such a voyage. "The most important and very necessary item of the equipment of any Arctic exploration is the ship, which must be especially built to withstand the shock of contact, the pressure and the grind of heavy pack ice. A common pan of ice, 50 feet by 30 feet by 15 feet, against which the ship bumps, grinds and piles her strength day after day, weighs 1,350,000 pounds (675 tons) and a symmetrical iceberg, 100 feet long above water, 200 feet long and 150 feet wide, has the prodigious weight of 1,620 million pounds. In comparison with such a weight the largest ship ever built is but a pygmy. Are we surprised then, that strong ships, caught between the relentless jaws of two approaching ice fields, have been crushed flat and even completely turned inside out? An Arctic ship should be as small as possible; that is, not one whit larger than is necessary to carry equipment and provisions of the personnel, plus the element of seaworthiness in traversing the waters en route to its objective point. Theoretically, a small ship can be constructed sounder than a large one; she will lift more easily when under pressure; she will negotiate narrow leads and turn sharper corners; she can hug the land for safety and take refuge in smaller harbors and she is more economical.

"The ship should be constructed of wood, the very best of oak frame, oak planks and outside sheathing of ironwood, for wood is more resilient than iron and a better nonconductor of heat or cold. For navigation in such dangerous waters she should have the double margin of safety by being well equipped with both sail and power, for propeller blades are easily bent or stripped and shafts broken. Her fuel should be oil for economy of bunker space and crude or kerosene oil in preference to gasoline, thus decreasing to a minimum the danger of fire through ignition of fumes from a leaky pipe or tank, caused by a 'squeeze' or 'nip' when held fast in the grip of the ice pack. The BOWDOIN was able under sail, strong under power, lay like a duck in rough weather and quick to answer her helm in working through leads and strong to resist shoals or heavy pans."

Her construction was financed by the MacMillan Arctic Association and she made her fourteen months' voyage to the west coast of Baffin Land, 150 miles north of the Arctic Circle, in order to establish a magnetic station for the Carnegie Institute of Washington, D. C., and the Boston Globe and to explore hitherto unknown shores and interior lakes. Setting sail from Wiscasset, Maine, on July 1, 1921, the BOWDOIN was given a fitting farewell by Dr. MacMillan's friends, and her voyage of 5,000 miles commenced. With him was a party of seven, all selected because of peculiar fitness for such a voyage, where a man must not only be perfectly sound of body but of such disposition that the confined life on the ship for months will not ruin his nature. Harold Whitehouse, of Linekin, Maine, was engineer in charge of the 45 h.p. three-cylinder Fairbanks Morse oil-engine and Thomas McCue, of Maryville, Newfoundland, as cook, attended to the important work of producing nourishing meals on the Shipmate range. In addition to these were Jonathan C. Small, of Provincetown, Mass.; Mr. Robinson, G. Dawson Howell, Jr., of Boston Mass., and Richard Goddard, of Winthrop, Mass., magnetic observers, and Abram A. Bromfield, Jr., interpreter, of Jackalanes Bay, Labrador. Stopping at Halifax, N. S., and Sydney, N. S., for final preparations, provisions, and to fill the fuel-tanks to capacity the BOWDOIN made the final departure from the latter port, at which she was accidentally rammed by a steamer, but without inflicting damage.

Alternately under sail and engine power the BOWDOIN navigated along the Newfoundland and Labrador coasts, through the Straits of Belle Isle and threaded her way between icebergs suddenly looming alongside in the fog and darkness. Had the engine failed for one minute when negotiating these narrow passages, filled with extremely strong tidal currents and strewn with great icebergs and ice-

Dr. MacMillan's Fairbanks Morse-engined Arctic ship "Bowdoin"

The "Bowdoin" in Winter quarters far above the Arctic Circle

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floes, the story may have ended here. At Battle Harbor, headquarters of Dr. Grenfell's mission, Dr. MacMillan and his party enjoyed the hospitality of Dr. Hazen of his staff and rearranged deck cargo, transferring case-oil into the tanks.

The summer was passing and the northern bays and inlets had by now disgorged their millions of tons of ice so that entrance was possible. The BOWDOIN therefore set sail from Battle Harbor on August 7 for the North. Her final farewell to the American flag was at Domino Harbor, where, surprising though it may seem, Dr. MacMillan met George G. Williams, of Hartford, Conn., cruising in his auxiliary schooner-yacht, NORSEMAN, which was also built at East Boothbay, Maine, by Frank Adams, only a few yards from the BOWDOIN's birthplace. Continuing down the forbidding coast, Indian Harbor was entered, this being the place from which Peary, on September 5, 1909, flashed his first message by Marconi wireless: "Stars and Stripes nailed to the Pole!" At Hopedale—site of the Moravian Mission station—the BOWDOIN dropped anchor again and Dr. MacMillan set about the task of engaging an interpreter, finally engaging Abram Bromfield.

Down further toward the entrance to Hudson Bay the scenery became most strikingly picturesque, "deep, dark fjords, wonderful color effects and big hills, rising to a height of 6,000 and even 7,000 feet." With a man in the crow's nest (lookout high on the mast) to detect rocks, shoals and clear water the BOWDOIN made her way, a considerable part of the journey, into Hudson Bay and up the coast. From the Hudson Bay Company's post the last mail was dispatched home and arrangements were made to procure assistance in the event of the loss of the BOWDOIN further north.

And well might such arrangements be made, for the BOWDOIN headed north into unknown waters on which only one ship had ever sailed, the CHARLES, under command of "Northwest" FOX, bearing a letter from the King of England to the Emperor of Japan. But this was 290 years ago. Many have ventured into the narrow passages between the bleak shores of the North, but have been unable to stem the swift currents. Of this, Dr. MacMillan says: "The same current is still there, but the modern engine conquered it and on we went a few hundred yards from shore." More than once did the BOWDOIN narrowly miss ledges just covered by swirling waters, pans of ice suddenly appearing under her bows and more than once did the lookout aloft on the mast give warning just in time for the helmsman to spin her wheel and thus dodge the ice. But it was not always possible to dodge and her steel-sheathed bow smashed into solid ice many times.

As the summer was passing rapidly by this time all haste was necessary in reaching the desired position farther north, so with sails filled and the engine running steadily the BOWDOIN was driven toward Fury and Hecla Strait, the objective. Often it was impossible to use sails and when nothing but ice was visible in every direction the Fairbanks-Morse oil-engine was equal to the demand and brought the BOWDOIN to blue water. Thus MacMillan fought his way north and wintered. Our illustrations show the BOWDOIN, in which the winter was spent, as well as conditions surrounding her for many months. But of the engine which so ably drove the vessel north and withstood the rigors of an Arctic winter we can do no better than quote Dr. MacMillan when he wrote as follows:

"Naturally, following our long imprisonment of 274 days in the ice at 64 degrees north latitude, during which time the BOWDOIN was frozen in the solid ice with temperatures as low as 60 below zero, Fahrenheit, I had grave doubts as to her starting readily when released from the pack on the first day of August. I also feared that due to such extreme cold certain parts of the mechanism might have been seriously injured through excessive contraction. We had simply drained the water off in the Fall and left the engine as she was without even taking off a cylinder head. We heated the plugs, turned on the air and she was off as if she had stopped the night before."

On the strenuous trip north through the ice the Hyde bronze propeller of the BOWDOIN was very badly bent through contact with ice and before starting on the return voyage to the United States the BOWDOIN was beached and the bent propeller blades straightened out. Incidentally, the ability to straighten bent propeller blades is one advantage of the bronze propellers over the steel or iron propeller blades so often installed and it would certainly seem that for any boat operating in Winter conditions a bronze propeller is a necessity.

So the long return voyage was begun, not without its perils. But valuable scientific data had been obtained, magnetic stations established and, incidentally, it had been proven that the oil-engine was master of any condition it could be pitted against, for no other type of machinery in a vessel of the size of the BOWDOIN could have performed the service which this 45 h.p. Fairbanks-Morse oil-engine performed.

Dr. Donald B. MacMillan in Arctic togs on board the "Bowdoin"

# Morse Dry Dock Co.'s New Enterprise

## *Establishment of a Diesel Engineering Department*

WE have just received an interesting announcement issued by the Morse Dry Dock and Repair Company relative to the organization of a Diesel-engineering department. It presents a new angle of approach to this important problem and offers much in the way of constructive value to the motorship industry. Owing to the fact that there are so many types and makes of Diesel engines, both foreign and domestic, and that the principles of design, manufacture and performance are still undergoing important and rapid change, it is a difficult matter for the average shipping executive to gain a proper perspective and unprejudiced advice relative to the commercial, technical, mechanical and operating phases of the motorship problem.

In addition to developing the special shop equipment necessary to handle all phases of Diesel conversion and repair work and organizing a broadly experienced mechanical staff specialized in such work, the Morse Diesel department contemplates supplying as an important item of free service to Diesel operators or prospective converters, broadly experienced and competent advice regarding any and all aspects of this new form of marine drive.

Louis R. Ford is the manager of this newly created department. Mr. Ford has been engaged in the designing, building, installation and operation of Diesel engines, both large and small, and during recent years has made an extensive study of the important business and financial considerations that present themselves to an executive when he considers the possibility of acquiring motor-driven ships.

We understand that the policy of the Morse Company throughout is one of impartiality and unbiased professional judgment regarding the type and make of engine best suited for any given condition. Shipping executives will thus be assured of experienced and competent judgment, and engine manufacturers will know that the merits of their respective products will be unswayed by any affiliations.

The scope of the activities of this department are very complete, covering as they do the problem from the point of the executive's original business analysis of his motive-power problem down through the consideration of technical matters relative to selection of size, types, etc., and their incorporation into given hulls. From this point of advisory service the work is carried through the shops and docks of the Company for the complete execution of conversion or repair programs. Added assistance in the selection and training of operating personnel is also furnished. In this policy the Morse Company doubtless will make a substantial contribution to the development of the Diesel industry in the work which they are undertaking.

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## ARRIVAL OF THE BIG OCEAN MOTOR-LINER

A REVOLUTION in engineering thought and an almost bewildering disturbance of shipping opinion has arisen over the construction of the 18-knot 600 ft. two-cycle Diesel-driven ocean passenger-liner for the Union Steamship Company. We who sit in the center of the wheel of current development knew that such a remarkable advance was nearer to realization than generally appreciated. On the other hand shipowners whose experiences with the operation of motorships are not personal, but largely heresay, genuinely believe such a vessel is impractical except on paper, and not possible as a commercial proposition within the next ten years. Their opinion has been supported by a considerable weight of engineering opinion; and there are engineers whom this bold order has disconcerted and rudely shocked. Most of these hold to the belief that with single-acting, multi-cylinder oil-engines of very high shaft horse-power per cylinder, the large diameter necessitated will produce excessive stresses from heat, the wall thickness being too great for efficient cooling. They also maintain that double-acting engines or electrical transmission are essential with such a high powered vessel. With all deference to this widespread belief the direct refutation of this school of thought is the fact that there is actually building to-day by a responsible shipyard, and for a reputable steam and motor ship-owning company, this 22,000 tons motorship to be virtually a duplicate of the largest, latest and fastest *Empress* liners of the C. P. R. fleet.

The builders are an old established and conservative concern, and while, to be sure, they have had no Diesel-engine construction experience worth recording, they will be assisted by the designing and engineering staff of a firm which has been most closely identified with the field for more than twenty years, and which in addition to extensive operations in Diesel engine construction has conducted very extensive experiments of note with a Diesel cylinder of over the horsepower involved in this case, and have built complete engines of 4,000 b.h.p. in six cylinders which have been in steady operation for several years in central stations.

The placing of this revolutionary order will be the greatest setback ever given to the geared-turbine and the steam-boiler by the internal-combustion engine. It will mean that from now onwards every shipowner will be forced to most seriously consider oil-engine power for vessels of all but the very largest size, as success of the new development is assured. Coming into being of such big motorships means economies that are astounding, and enormous compared with the gains effected by the "commonplace" (sic) Diesel-propelled freighter. Too much stress cannot be placed upon this factor, because it will be practically impossible for steam-driven liners to compete against them.

The Union Steamship Line's motorship is having four six-cylinder motors together developing from 12,000 to 13,000 shaft horsepower; and will maintain the first figure in regular service, which is the equivalent of about 13,750 steam i.h.p. for reciprocating engines and about 11,750 shaft h.p. for geared or electric turbo drives. Triple-screws and three engines were also considered for the job. The auxiliaries of the motorship will take another 1,500 shaft h.p. The cylinder bore and stroke of the main engines are 27" and 39" respectively, and the speed is 135 r.p.m.

Sometimes we are accused of painting the motorship in too rosy colors, but in actuality we strive for accuracy and give figures as we find them in service. While no performance data is available the daily consumption of fuel-oil at sea of this new craft will be only 57½ tons for 18 knots speed and under 6 tons per day in port. As she will operate on the Pacific Ocean, and as fuel-oil on the Pacific Coast is now $7 per ton, her fuel bill will have the extraordinarily low figure of $402 and $42 per day respectively, unless oil prices increase which, of course, will affect steamships to a much greater extent. But this is not her only economy. Her builders say that she will carry 18% more passengers and 18% more cargo than a steamer of the same dimensions and speed. Her speed will be more consistent because of absence of propeller racing and otherwise varying propeller speed, meaning a better voyage average. Also there will be a very extensive saving in her engine-room crew. Our figure of 57½ tons consumption at sea is conservative, because all the auxiliaries will not be running, whereas we have included the full 1,500 b.h.p.

If she were an oil-fired steamer of the most economical class she would burn 126 tons of oil at sea and about 40 tons in port, meaning daily fuel bills of $882 and $280, and would have a much smaller carrying capacity. The new motorship will make the trans-Pacific passage from Vancouver to Australia in 18 days, and we presume will stay about 5 days in port at each end. So her total fuel-bill for a round sea voyage and two port stops, or 46 days in all, will amount to $14,892, compared with $34,552 for the steamer at the current low oil price quoted. This shows a net saving in the fuel costs alone of $19,660 per round voyage, or over $157,280 per annum, which will be exceeded if the price of oil increases. To this must be added the extra income from the additional passengers and cargo carried, which will vary according to traffic conditions. Then there will be a saving of wages and food of the eliminated firemen of not less than $20,000 a year. Consequently, the grand total gain from these sources by the adoption of motor power as against oil-fired steam drive will be close on a quarter million dollars annually, or far more than will be required to offset interest on the higher first cost of the ship. It should be noted that the higher the price of oil-fuel the greater will be the saving effected by the motorship in competition with the oil-fired steamer.

Nevertheless the question arises as to whether or not we are correct in our opinion that the owners may have been justified in building this remarkable motorship between fifteen and twenty per cent. smaller in overall size and power, thus reducing the first cost and overhead considerably. The result would be a ship of the same capacity and speed as a steamer of 600 ft., and the fuel and crew economies would be even greater than recorded above. Doubtless this viewpoint will afford the Union Steamship Company and other shipowners much food for reflection, but other circumstances may determine this point. Nevertheless there is something valuable in it, as the burglar remarked when he opened the safe!

## EFFECT OF CRUISING RADIUS ON FUEL BILLS

CAREFUL management will allow about six months' supply of fuel to be taken on board by a motorship at the port of call on her route where oil is the cheapest, and without interfering with the cargo capacity. This is clearly indicated by the fact that during the past year 99 Diesel-engined motorships passed through the Panama Canal and of these only 28 took on fuel. Furthermore, the total amount bunkered by these vessels amounted only to 80,000 barrels, or 11,450 tons. At the Canal oil is expensive compared with similar fuel at Atlantic and Pacific ports.

## A NEW ANGLE ON SHIP OPERATION

ARE shipowners so accustomed to the many expenses which accrue from firemen troubles, boiler troubles, condenser troubles and winter troubles with steam deck-machinery and their attendant delays that they do not take this combined cost into account when comparing the initial prices of steamers and motorships? The money thereby lost is more appreciable than the interest on the higher first-cost of Diesel engines. In the operating cycles of a steamer over a ten-year period enormous sums from these causes are involved, and when an owner contracts for a new steamship he knows he will be bound to write-off these losses sooner or later. So why should the same be ignored at the start? Whereas, when he orders a new motorship he will not have to face these particular losses because such are absolutely eliminated with oil-engine drive. There are no firemen, no boilers or steam deck-machinery to give trouble or cause expensive delays at any time of the year. At the same time it is correct that with oil-fired boilers troubles with firemen are by no means as frequent as is with coal-burning ships.

The inception of the motorship has brought about many new angles to ship operation not yet properly recognized by the owner accustomed only to steam. By having two identical vessels designed and requesting builders for bids, one with steam and the other with Diesel power, shipowners only secure a distorted comparison, as indicated in another Editorial in this number in which it is pointed out that a motorship

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should be smaller over-all. Oil-engine propulsion has caused entirely new basic fundamentals, and if owners wish accurate comparisons of the financial aspects they must have two distinct designs of hulls produced with steam and Diesel machinery respectively, but with both craft laid-out to do the same work—not two hulls exactly alike differing only in the two types of machinery. They will discover that this will result in two distinct ships of similar net capacity having very little difference in first cost. But, one will be very much more economical to operate than the other.

A discussion of this phase of vessel operation is appropriate just now because of bids having recently been requested on two ships for the Red D Line. Quotations for steam and Diesel machinery were requested for the same hulls, and oil-engine propulsion was decided against after consideration for the one vessel ordered because the owners concluded under their operating conditions that the savings would not be sufficiently great to warrant the additional investment for Diesel engines. Besides, a 4-cycle, twin-screw installation was not found feasible as the weight would take away from the carrying-capacity of the ship on light draught. But we wonder if the same determination would have been reached in this or any similar case had the foregoing and following factors been given their proper value. The vessel in question is of the combination passenger-cargo class with limited draft due to a sand-bar at the end of the outward run, so the usual space gained through the fuel economy of Diesel power cannot be given over to cargo or passenger accommodations. The bar has to be crossed with the ship as light as possible, and only about 50 tons of fuel is left in the bunkers. Apparently the net value of the fuel saved is the principal gain to offset the higher machinery cost of about $100,000. The ship will be run on what is almost a coastwise route with many stops, the longest leg being five days.

However, one may ask if bids were asked on the design of motorship calculated to make the best showing against the steamer? Because of the unusually short runs on the route, much lighter-weight and faster-running Diesels might be employed with perfect safety. That is to say, trunk-piston engines with a speed of 200 to 250 r.p.m. would be perfectly reliable, and would mean a reduced first cost, also a smaller engine-room. There are many such sets in service. Even 275 r.p.m. may not be too fast; also reduction-gears or electric drive could be employed if desired. This would mean that the resultant vessel would be equivalent to a larger steamer and the cost per net-capacity ton would be about the same. In most similar cases the hull could be built smaller than that of the steamer, and this would make the first cost nearly equal, but does not seem to be practical on the Red D. route because the hull specified is considered the smallest practical. Yet the smaller motorship would do the work of the bigger steamer with lower upkeep, operating and standby charges, aside from the absence of firemen and their wages and maintenance.

In their capacity of counsellors it is the duty of naval-architects, on whom shipowners rely for expert technical advice, to outline all the various factors brought about by oil-engine drive. Entirely eliminating any personal suggestion in this particular case it is obvious that some naval architects do not know sufficient concerning the many factors of Diesel propulsion, due to their multitudinous tasks preventing time for the very deep study that is necessary to become fully posted; also the comparative newness of this type of machinery has not made available any standard and authentic records other than those in the confidential archives of motorship owners, or that have been published in this magazine. Our conception of the knowledge of these counsellers is largely based upon their papers read before the Society of Naval Architects, and through personal conversations with shipowners, who we are convinced have not been given all the angles of the case.

## THE WORLD-WIDE MOTORSHIP ADVANCE

IN most maritime countries, particularly in Sweden, Germany and Great Britain, shipyards engaged in the construction of motorships are the ones that have the most contracts on hand, signifying the trend of thought of shipowners to-day. Incontrovertibly there is a strong world-wide movement for the immediate adoption of the several systems of oil-engine drives, even by owners who a couple of years ago were dyed-in-the-wool sceptics. This tidal wave is now slowly sweeping through the United States with an irresistible rush impossible to dam. Profound impression has been made by the fact of more large Diesel-driven vessels having been launched into the world's service during the post-war period of the international shipbuilding slump than during the entire history of this type of power in the merchant-marine from its inception up to that date.

Although current steamship building is many hundred thousand tons astern of normalcy, recent official statistics reveal that never before were so many motorships on order, including a swift ocean liner of tonnage and power hitherto thought by most shipping men to be still in the dream stage. This remarkable ship will make the passage between Canada and Australia in eighteen days. One shipyard in Germany has under way for completion within one year thirteen motorships aggregating 113,000 tons, of which two Diesel-propelled freighters are of 21,000 tons each, and in addition a number recently completed. German shipowners are ordering motorships because they fully realize that their new mercantile marine must be the acme of efficiency if their old maritime position is to be regained.

With the passage of the Ship Subsidy Bill will come many orders for new American motorships, and these will only be exceeded in numbers by conversions of existing fuel-wasting steamers to economical motor power. There are actually $25,000,000 in the treasury of the Shipping Board available for loaning toward new motorship construction, whether or not the bill passes. Credit is due American Diesel-engine builders for having foreseen this situation and for having at enormous costs developed and produced marine power plants second to no foreign-built engine in design and workmanship. Shipowners and shipbuilders have available in these factories sufficient facilities to convert the entire American merchant-fleet. In urging and encouraging shipowners to make use of the same, shipbuilders will be feeding the goose that is to lay the golden egg.

## POWER FOR WORKBOATS AND TECHNICAL ADVICE

THE gasolene engine is doomed in the workfield just as the death knell has been sounded on all forms of steam drive for the propulsion of cargo-vessels. Not only bread-earning boat owners cannot afford to operate engines burning fuel costing twenty cents a gallon in competition with craft running on fuel costing only three to five cents for the same quantity and running for a twenty percent longer period because of greater combustion economy, but they are not content with such conditions. In fact, increasing cost of operating and living conditions makes the use of expensive fuel intolerable to them. All over the country commercial boat-owners are scrapping their gasolene plants as rapidly as they can accumulate sufficient funds to pay for the more economical power, even if it is somewhat more expensive initially. MOTORSHIP regularly devotes considerable editorial space to the operation and construction of the oil-engined work-boat. We have a special department for this purpose to which a well-known naval architect, who was brought up in the work-boat and yachting field, devotes his entire energies in direct co-operation with the Editor. As an auxiliary to our editorial articles we are at all times glad to assist work-boat, also yacht owners, with technical assistance regarding the conversion of gasolene boats to heavy-oil power, or with the building of new oil-engined craft. All communications dealing with this subject should be addressed to our Work-boat Forum. Special space will be given in our editorial pages for questions and answers of this nature.

## SECOND WORLD VOYAGE OF THE "WILLIAM PENN"

AGAIN has the American motorship WILLIAM PENN voyaged around the world, not only repeating her record made on the first voyage, but improving upon it. Her performance, given in detail last month, reflects the utmost credit upon all concerned, proving again conclusively that America can build and operate motorships. For it must be remembered that, while the machinery of the WILLIAM PENN was built by Burmeister & Wain of Copenhagen, the Wm. Cramp & Sons Company erected and installed the machinery and aided in training the engineers in the knowledge of the details of the machinery in such perfect condition. The official report of her chief engineer, which we reproduce by kind permission of the U. S. Shipping Board, may prove to be an eye-opener in some circles.

The performance of the WILLIAM PENN is remarkable in the eyes of ship operators who still regard the Diesel-engine from the basis of performances of early installations, in that on two round-the-world voyages so far concluded there have been no involuntary stops because of the machinery and no repairs except very slight adjustments made in the ordinary course of any engineer's work on board any ship driven by machinery. At the conclusion of both voyages she could have touched the dock and immediately have started on another round-the-world voyage as soon as sufficient fuel was taken aboard. Nevertheless such service is bound to be usual in the case of all motorships when engineers devote themselves so completely to maintaining the machinery in such perfect condition.

The record of the WILLIAM PENN as well as of other American motorships such as the CALIFORNIAN, MISSOURIAN, KENNECOTT, BAYONNE, SOLITARE, H. T. HARPER, and others is a distinct contradiction to the statement that Americans do not readily take to operation of Diesel engines.

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# Holland's Diesel-Electric Submarine Mothership

## *Further Details of First Vessel of Its Kind in Any Navy*

IN the PELIKAAN, which was first illustrated and described in our issue of October, the Royal Dutch Navy has pointed the way for other navies to follow in the construction of their future vessels. Submarines generally require frequent attention and overhaul so a submarine mothership must be well equipped with repair-shop facilities, winches, wireless, submarine signalling apparatus, etc. —equipment requiring electric power. Therefore, it is good policy to fit a craft of this class with electric-drive throughout. The PELIKAAN is such a ship.

As stated in October, she is of 2,400 tons displacement and was built by the Netherland Shipbuilding Co. of Amsterdam, Holland, and ran trials in June. She is destined for service in the Dutch East Indies. Her complete power-plant was furnished through the Kon. My. de Schelde of Flushing, Holland, including the propelling-engines that were built by the Maschinenfabrik Augsburg-Nürnberg, and the electric-generators and motors which were constructed by the Electrotechnische Industrie of Slikkerveer, Holland. She is of steel construction, the peculiar form of stem being due to the fact that it is equipped to hoist weights up to 40 tons.

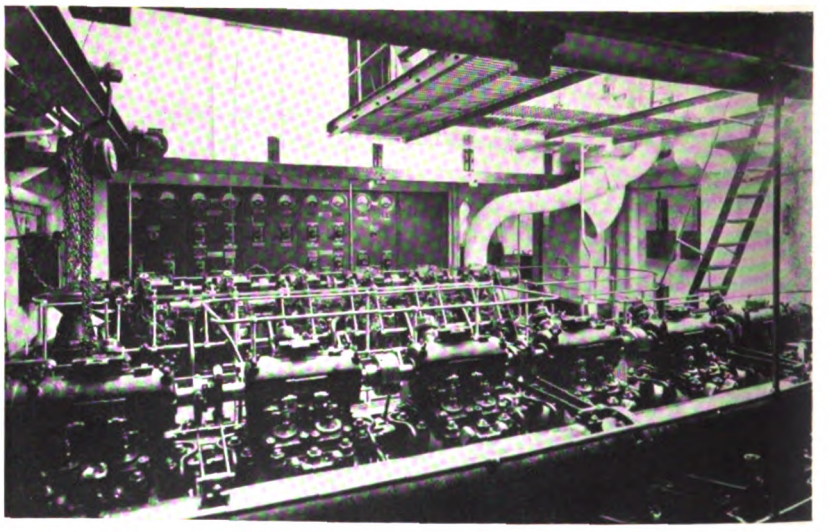
From the mechanical standpoint the PELIKAAN offers exceedingly interesting features. She is, it will be remembered, propelled by two six-cylinder two-cycle M. A. N. Diesel-engines of 700 shaft h.p., each driving a generator of 468 K.W. 1,200 amperes 390 volts, delivering current to two direct-current propelling-motors of 570 shaft h.p., 1,200 amperes, 380 volts, that drive a three-bladed propeller at 190 r.p.m. Both generators can drive each propelling-motor and one generator can drive both motors. The main switchboard is in the engine-room on the port side. Connected to a 50 h.p. Diesel-engine are two compound direct-current motors of 32 K.W., 220 volts, 145 amperes, these furnishing electric-current for ship's lighting, steering-gear, winches, motors of machines in the repair shop, converters, etc. The auxiliary Polar Diesel engines have four cylinders and not three as quoted in the October issue and the exciter-generators are of 220 volts rather than 22 volts as stated.

On the awning deck is a 25 h.p. Kromhout oil-engine driven dynamo forming an emergency electric-lighting and power-set, the power also being used by the electric boat-winch for hoisting small-boats on board. An emergency bilge-pump is placed on the 'tween-deck in the vicinity of the refrigerating-room, this being in addition to the regular bilge-pump. In addition to the hoisting-apparatus on the stem, there is also an electric-winch on the bridge-deck just forward of the fore-mast, and forward of the main-mast there is also an electric-winch for hoisting small-boats. Two electrically driven windlasses aft on the upper-deck and a windlass on the forward-deck are provided. There is a search-light on each mast and four machine-guns and four anti-aircraft guns of 7.5 cm. are placed on deck. There are two complete refrigerating-plants each capable of supplying 150 kg. of ice every 24 hours. Ammunition stores are kept in a cooled space. In addition to the usual magnetic compasses there is a complete Sperry gyro-compass installation, a 4,000 km. range wireless installation, submarine-signal apparatus and electric-hydraulic steering-gear.

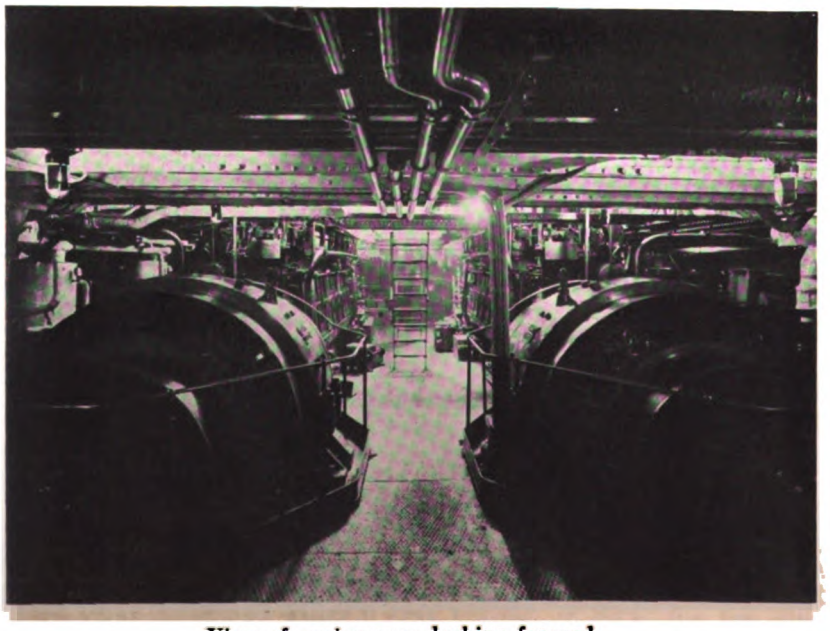
For the important work of keeping a submarine-fleet in perfect condition the PELIKAAN is virtually a floating repair-shop, being equipped with machines and spare parts for repair of torpedoes, accumulators of submarines, and for refilling oxygen-cylinders of submarines lying alongside. For this latter purpose there is an "oxygen store" containing a battery of 24 cylinders of compressed oxygen connected to a special pump by which the oxygen can be transferred to submarines. There are also stored in this room 72 cylinders of compressed carbonic-acid. Diving-suits and equipment used by divers, spare parts for submarines, supplies of sulphuric-acid, and distilled-water, both in bottles and in tanks, are also provided. On deck there is space for two sea-planes, which are hoisted on board by means of an electric-winch and derrick on the main-mast. There are three tanks for benzine for the sea planes and motor boats also on deck. Carrying such a quantity of miscellaneous combustible material, it is quite necessary that adequate fire-extinguishing apparatus be installed, so we find on the first 'tweendeck a battery of cylinders containing compressed carbonic-acid which can be immediately used.

For work in the East Indies the crew will be composed of both Europeans and natives, each group having their complete living ac-

Three-quarter view of the "Pelikaan"



Valve-gear of the twin Nurnberg, two-cycle Diesel-engines



View of engine-room looking forward

Room of the officers in command of the "Pelikaan"

Diesel-electric Warship "Pelikaan" of the Royal Dutch Navy

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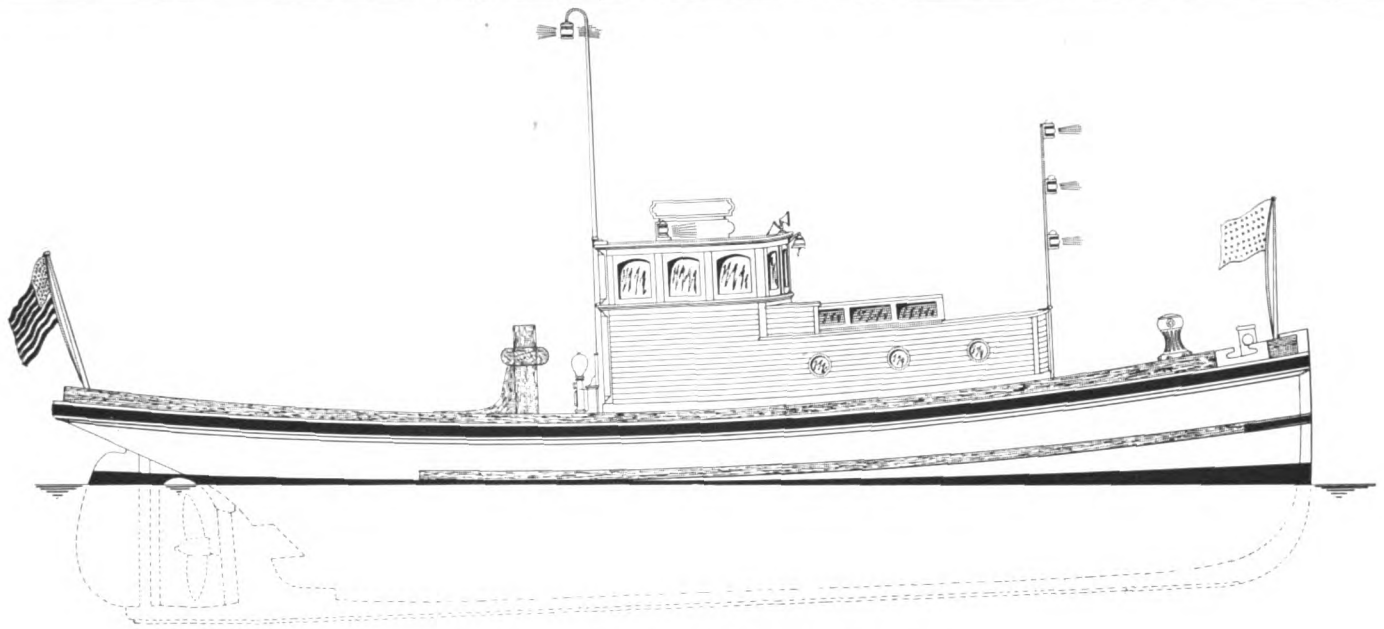
commodations separate. For the commander of the ship there is on the awning-deck a suite consisting of sitting-room, state-room, pantry, and bath; aft on the same deck are four state-rooms for the first officer of the PELIKAAN and for the commanders of three submarines. Other officers of the PELIKAAN are accommodated in state-rooms on the upper-deck and on the two 'tweendecks, either in one- or two-berth rooms, and for all officers there is a large wardroom on the upper-deck. The officers are of course European, but the petty-officers and crew will be both European and native. The European petty-officers have a large ward-room on the first 'tweendeck and sleeping accommodations on the second 'tweendeck; while the native petty-officers have their wardroom on the first and sleeping quarters on the second 'tweendeck. On these decks are also accommodations for European and native crews and there is a hospital, containing 12 beds, an operating-room, pharmacy, and bath. In addition to the ship's regular officers and crew she must also provide accommodations for the officers and crews of four submarines and also provide space to store the inventories of six submarines.

Undoubtedly the PELIKAAN offers considerable opportunity for study as she contains a wealth of equipment in a small ship and it is to be expected that the efficiency of a fleet of submarines accompanied by such a mother-ship must be high.



Profile of the Coos Bay Lumber Co. Diesel-Tug

# Lumber Company Builds Diesel-Tug

***Typical West Coast Tug-Boat from Dickie Designs to Have Enterprise Diesel-Engine***

THERE is no stronger indication of the trend of new marine installations in work-boats than the increasing number of tug-boats being equipped with Diesel and surface-ignition oil-engines; especially on the West Coast have the advantages of oil-engine power been recognized and airless-injection has met with considerable favor. The latest installation of an Enterprise airless-injection Diesel engine in a tug-boat is found in the new craft for the Coos Bay Lumber Co. of Coos Bay, Oregon, now under construction by Nunes Bros. at Sacramento, Cal. This boat is being built from designs by David W. Dickie, of San Francisco, and she is of a type similar to the GOVERNOR STEVENS, the San Francisco harbor-inspection boat just completed from his designs, and illustrated in our September issue, page 681.

A glance at the accompanying illustrations will give a good idea of the general arrangement and construction of the new Coos Bay boat. In operating this tug, the one man system, which has been so popular on the West Coast, has been adopted, the operator starting the engine, watching it until it is properly warmed up and operating smoothly, and then going into the pilot-house where he can operate the boat by controls located there. The tow-lines are handled by a deck hand, although the after-bitts are close to the pilot-house.

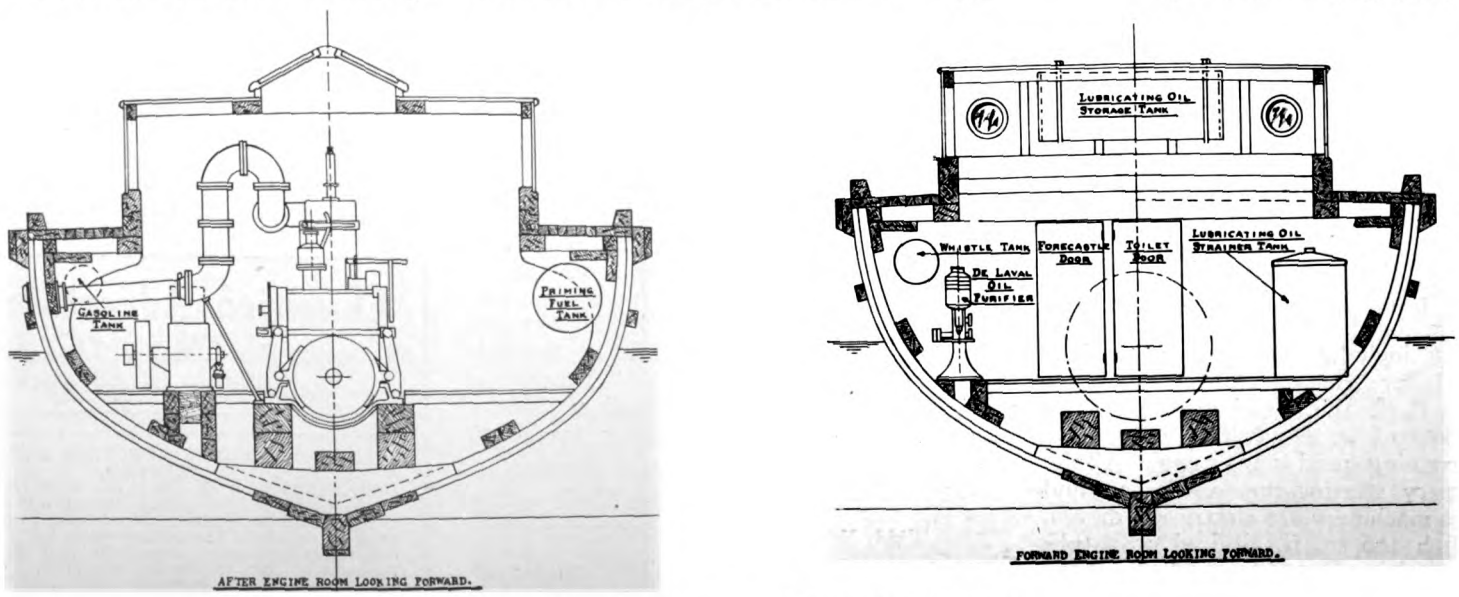
The general dimensions of the boat are as follows:

| | | |
|---|---|---|
| Length over all | 57′ | 0 ″ |
| Displacement length | 50′ | 0 ″ |
| Beam over plank at the deck | 16′ | 0 ″ |
| Draft at sternpost | 6′ | 6½″ |
| Freeboard at lowest point of sheer | 2′ | 5½″ |
| Depth top of deck at side to rabbet amidships | 7′ | 10 ″ |

The length of 57′ 0″ is determined by the distance between the wharves in San Francisco Harbor. With a properly designed boat 57′ 0″ over all it is possible, where the boat is lying heading in to the sea-wall, to swing her bow away from the wharf, put the helm hard over and make the complete turn and clear the wharf on the opposite side of the slip. It is necessary to "back and fill" with a sixty-foot boat unless the maneuver is very carefully made. To take care of the increase in weight of the Diesel boat over the gas boat where draft is limited it may be necessary to lengthen the boat to 58′ 0″.

The heavy-oil engine having supplanted the distillate-engine where economy is a factor, F. A. Warner, Vice President, and E. A. Fiske, Purchasing Agent of the Coos Bay Lumber Company, called for bids on all types,

(*Continued on page* 946)




Sections through engine-room of Enterprise Diesel-Tug

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# Gotaverken Dual Motorship Event

## *Trials of the Grangesburg-Oxelosund 8,300 Tons Ore-and-Oil Carrying Motorship "Lulea," and Launch of the Sister Diesel-Driven Vessel "Luossa"*

IN these days of quiet business in the shipyards of the world it is unusual for a launching and a trial trip to occur on the same day. Such an event becomes of special interest when both craft are propelled by oil-engines. This recently took place at the Götaverken of Göteborg, Sweden. The new combination oil- and-ore carrier LUOSSA having glided down the ways at 10 o'clock on the morning of September 23, the launching party immediately proceeded to the sister motorship LULEA which then started on her trial run. Both events were successfully carried out.

During the lunch on board the LULEA the President and Directors of the owning concern, the Grangesburg - Oxelosund Company of Stockholm, declared themselves satisfied in every way—not only with this motorship, but with the other ships delivered to them by Götaverken and now operating in the ore trade. Special emphasis was placed upon the success of the motorships made in service.

It will be recalled that the Grangesburg-Oxelosund Company several years ago placed a contract for eighteen steamships, and that while the first two vessels were under construction the contract was changed, making the balance of the fleet to be Diesel-driven. The LULEA and LUOSSA are part of the program of sixteen motorships. In fact, it is interesting to record that when the launching party returned to the Götaverken they found the keel of a 10,000 ton ore-and-oil carrying motorship for the same company laid on the vacant berth, so it was really a triple rather than a double event.

On page 837 of our November issue we illustrated the motorship LULEA, while in this number we give an illustration of the launching of the LUOSSA. The remainder of the fleet will be 10,000 tonners. (See page 676 Sept.)

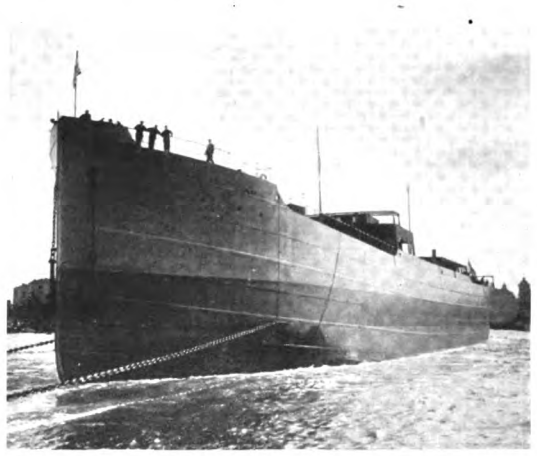
The dimensions of both these vessels are as follows:

| | |
|---|---|
| Dead weight capacity | 8,300 tons |
| Bunker capacity | 550 " |
| Oil cargo capacity | 1,650 " |
| Length o.a. | 399'3" |
| Length, b.p. | 385'0" |
| Breadth (moulded) | 53'5" |
| Moulded depth to main deck | 26'0¾" |
| Draught on summer free board | 25'3⅛" |
| Speed | 11 knots |

While the main purpose of these vessels is to carry ore, deep tanks are provided in addition to the double-bottom bunkers especially for the purpose of carrying oil as cargo from oversea ports to Sweden, which country has no natural oil supply. Because of the small fuel consumption of her main and auxiliary engines bunker capacity for only 550 tons has been provided. Twin Götaverken built B. & W. type four-cycle Diesel engines are installed, developing together 2,600 i.h.p. at 130 r.p.m.

On the trials the LULEA averaged a speed of 11.56 knots, the propeller slip being 5.8 per cent. The recorded fuel-consumption was 0.133 kg. per i.h.p hour for the main engines. and 0.140 kg. including all auxiliary machinery. The latter comprises three 75 b.h.p. Götaverken - B. & W. Diesel engines direct-connected to 50 k.w. 220 volt D. C. generators. The running speed is 325 r.p.m.. All the deck machinery, steering-engine, windlass and engine-room machinery are electrically driven, but there is a 100 sq. ft. oil-fired cross-tube boiler for supplying steam to the heating apparatus, emergency air-compressor, distiller, donkey-boiler, feed water pump, injector and oil-burning apparatus.

Following Götaverken practice this is the only steam equipment on board. To handle the bunker-oil and the cargo-oil there is an electrically-driven pump of 300 tons per hour capacity and one electrically-driven pump of 100 tons per hour capacity.



**Launch of motorship "Luossa" at the Götaverken**

### FOUR GERMAN MOTORSHIPS PURCHASED BY AMERICAN CONCERN

Operation of a line of four motorships in a passenger-and-freight service between San Francisco and San Pedro, California, and Salina Cruz, Mexico, by the United Fruit Distributing Company of Los Angeles began the first of November with the sailing of the PRINCIPIO, formerly the German vessel ERNA DAVID, from the California ports for Mexico. Three former German mine-layers, equipped with Diesel engines, also have been purchased by this company and will be brought to the Pacific Coast in the near future.

The PRINCIPIO was built at Flensburg in 1920, is 185 feet in length over all, a beam of 25 feet, a loaded draft forward of 8 or 9 feet and aft of 12 or 13 feet, and has a cargo capacity of 1,000 tons. Her twin-screws are driven by two 300 shaft horsepower Diesel engines, while her auxiliary equipment is electrically operated. The ship carries a crew of 18 men. Originally there was only one hold, but 'tween decks were installed, a flush deck built and the housing remodeled before the PRINCIPIO left Germany. She arrived at San Pedro from Hamburg in September. A cold-storage plant was installed at San Pedro. Temporarily these boats will be operated under the German flag until arrangements can be made for transferring them to Mexican registry. Bananas are expected to constitute the principal northbound cargo.

### OPINIONS—ALSO FACTS, DIFFER!

In its issue of November 11 *Nauticus* says: "In spite of the somewhat noisy campaign conducted on behalf of internal-combustion machinery as a prime mover for marine propulsion, the geared-turbine is holding its own remarkably well, and still dominates the field of marine engineering." . . . "Owners and engineers are not going to Diesel machinery, but rather back to reciprocating machinery and Scotch boilers."

### WILL HANDLE JENKINS VALVES

Wm. Compte has been appointed sales-manager of the New York territory for the marketing of Jenkins valves manufactured by Jenkins Bros., 80 White Street, New York City.

### ENGINEERS DEPARTMENT TO BUILD ANOTHER DIESEL SHIP

Bids are about to be asked by the U. S. Engineer's Office of the War Department, Cincinnati, Ohio, on a new 24 in. Diesel-driven pipe-line dredge, and specifications will shortly be issued. The power will consist of a 1,000 b.h.p. McIntosh & Seymour four-cycle type Diesel-engine turning at 150 r.p.m. and driving a 4 ft. impeller. For this purpose one of the Diesel engines built for the Shipping Board will be used. For auxiliary purposes there will be two electric generating sets each driven by a 225 b.h.p. Diesel-engine. Open bids will be asked on this equipment. The length of the vessel will be 175 ft. by 50 ft. breadth by 8 ft. draft. For drawings see facing page.

### STANDARDIZATION FOR MOTORBOAT EQUIPMENT

The Society of Automotive Engineers, the headquarters of which are in New York City, is engaged in the important work of standardizing all equipment of boats. A Standards Committee, composed of many representative men in the boat and engine industry, are now at work through sub-divisions on various features. William J. Deed, assistant editor of MOTORSHIP, is the sub-division on stuffing-boxes and is endeavoring to outline standard stuffing-boxes for shafts which will meet all the requirements of all the manufacturers and will facilitate work of both new construction and repair. Mr. Deed is also one of a sub-division working to establish a standard nomenclature for the boat and engine industry so that every part of similar machinery, equipment, fitting, etc., will be designated by the same name, thus avoiding much confusion now existing. Any suggestions or comments on these matters will be gladly received by Mr. Deed.

### DOUBLE-ACTING DIESEL ENGINES

Working practice in the design of large double-acting two-stroke engines was the subject of an interesting and complete paper read by A. E. L. Chorlton on November 3 before the North East Coast Institution of Engineers and Shipbuilders, a copy of which we have before us as we close for press. The paper treats the parts of the double-acting two-stroke internal-combustion engine, one by one, giving the original design, experiences made, and the final design resulting therefrom. It is illustrated by numerous diagrams. The following types of the engine are considered:

1. Single piston, single piston rod.
2. Single piston, double piston rod.
3. Double piston, single piston rod.
4. Special.

A number of engines are described under (4).

The following principal parts of the engine are dealt with in detail: Cylinders, cylinder covers, pistons, piston rings, piston rods, piston-rod packings, crankshafts, materials. The paper also deals specifically with lubrication and exhaust-heat boilers.

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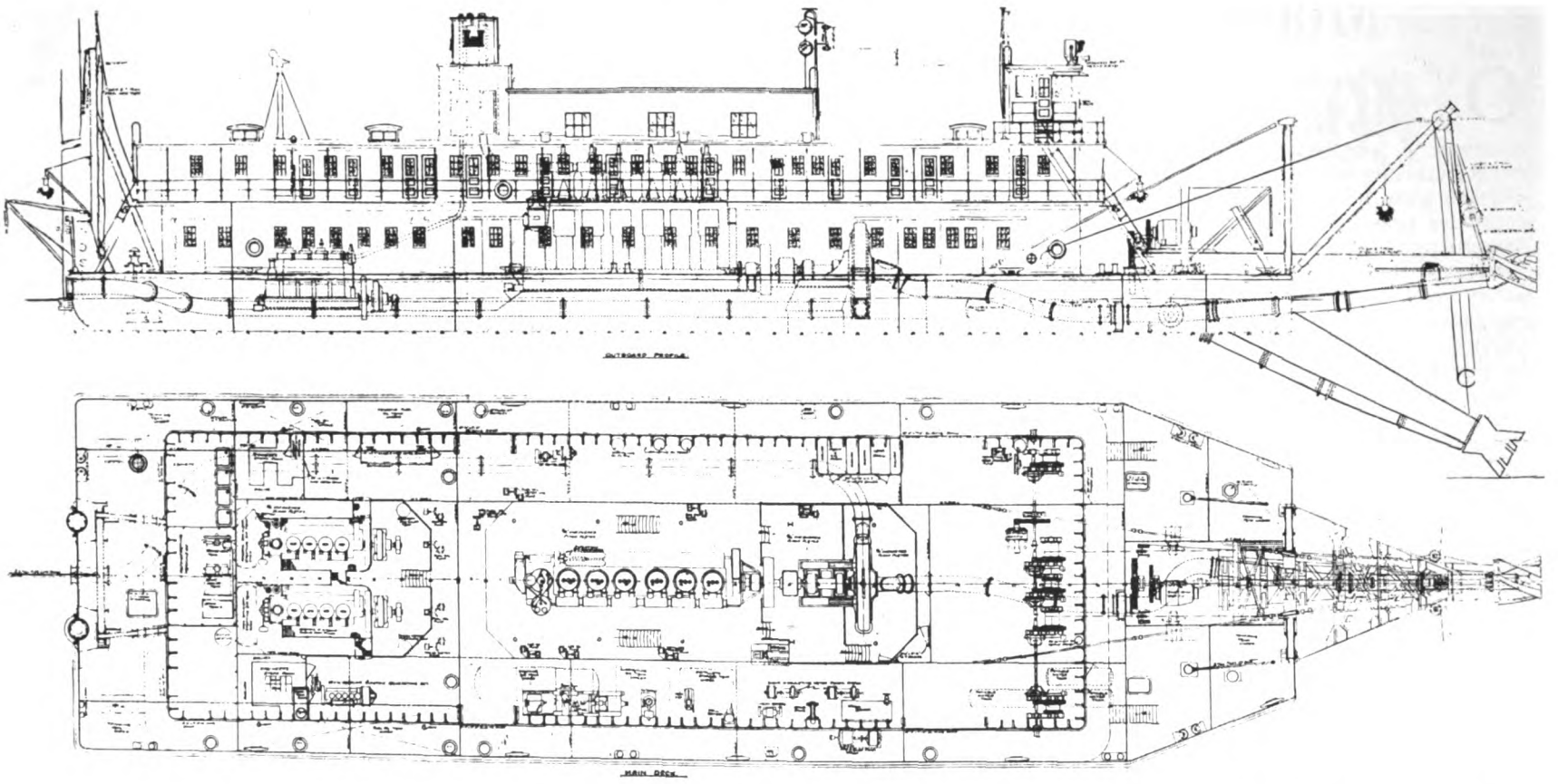

U. S. War Department's Diesel-engined 24″ pipe-line dredge designed by the U. S. Engineers Corps at Cincinnati, Ohio. A 1,200 i.h.p. McIntosh & Seymour crosshead-type Diesel engine drives the impeller. There are two 225 b.h.p. Diesel-electric auxiliary sets for which open bids are being invited. Tenders to build this novel vessel are about to be requested. For a description, see the facing page.

## REVIEWS

*FRISCO Standard Heavy Oil Engines,* Marine & Stationary. Bulletin 21, Issued by Standard Gas Engine Co., Oakland, Cal. This new bulletin describes the product of a firm well known in the internal-combustion engineering field. Their heavy-oil engine is profusely illustrated, and clearly described, specifications included and a most complete dimensioned installation drawing and list of equipment is given. The two latter features are all too often omitted from the literature of engine manufacturers. In the completeness of equipment and spares furnished we believe the above company is following a method which all engine manufacturers could adopt. Operators of oil-engines appreciate receiving complete equipment and spares as a mark of service and especially are these features appreciated in the case of the above manufacturers, as their engines are shipped to many distant parts of the world. Likewise is appreciated the exceptionally comprehensive scheme of construction which permits of the entire engine being taken apart so as to be transported in small, light parts and quickly assembled. This feature should be much appreciated for installations made in parts of the world where all materials must be handled by crude means, transported by pack-mule, coolie, etc. Copies of this bulletin will be mailed by the company to readers of MOTORSHIP interested upon mentioning this reference.

*Bulletin of the Burmeister & Wain Marine Diesel-Engine.* Brochure issued by Burmeister & Wain, Copenhagen, Denmark. This little brochure consists of tables giving the number of motorships over 2,000 tons in service on certain dates, as shown by Lloyds Index, name of ship, gross tonnage and make of Diesel-engine and type (whether two or four cycle) being given. The number and total gross tons of Burmeister & Wain engined ships as recorded on Dec. 28, 1921, were 67 and 383,297 tons respectively, while on Feb. 28, 1922 these figures became 73 and 426,809 tons and on April 25th, last, 78 ships of a total gross tonnage of 456,236 tons. Similar figures on motorships powered with other types of Diesel-engines are given in each of the above lists for comparison, but the same do not tally with the list in the 1922 MOTORSHIP YEAR BOOK.

*Burmeister & Wain's Stationary Diesel-Engine.* Care and pride in producing a perfect mechanism is often displayed in the high quality of the manufacturer's literature describing that mechanism. While attractive literature will not necessarily insure equally high quality in the engine, yet we somehow feel instinctively when we peruse such a catalogue that the engine must be of the same quality. And in the case of Burmeister & Wain we know this to be true. Not only does this catalogue of stationary Diesel-engines afford comprehensive information and data, but gives views of the plant which produces them.

*Lloyd's: Yesterday and Today.* By Henry M. Grey. Published by Syren & Shipping, London, 1922. 115 pages. Certainly no name is more familiar to the shipping world than that of Lloyd's. The precise date when Edward Lloyd established his coffee-house in Tower Street, London, is unknown, but from that little rendezvous of sea captains, owners and shippers, sprang the Lloyd's of to-day. It is known that the establishment was in existence in 1688, although the world-famous Lloyd's did not become an organized institution until 1774. The history of its rise and sketches of the men who have brought Lloyd's to its present position, as written by Mr. Grey, prove fascinating reading.

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*Schnellaufende Dieselmaschinen.* — (High-Speed Diesel Engines. Descriptions, experiences, calculation, construction and operation.) By Prof. Dr. Ing. O. Föppl. Dr. Ing. Strombeck and Prof. Dr. techn. L. Ebermann. Second edition 227 pages, 155 illustrations. Berlin 1922. Copyright, Julius Springer, Berlin. Reviewed by Dr. Carl Commentz.

This manual on high-speed Diesel-engines has been considerably enlarged with its second edition. Descriptions and drawings now embrace all important and recent German constructions of this type of engine, including the new designs of the M.A.N. and Körting Companies. Chapters dealing with the control of air-injection pressure, torsional vibration, and the adaptation of submarine engines for industrial purposes have been added, as well as much other interesting matter.

The most important addition is this section dealing with the calculation and construction of high-speed Diesel engines, written by Prof. Ebermann, who by the way, was prominent in the development of the submarine engine. Up to 1918 he was in the M.A.N. Works and in co-operation with Dr. Imanuel Lauster, assisted to produce the now famous Augsburg submarine engine. Thus, the knowledge and experience of prominent Diesel experts have been summarized in the book.

It will be recalled that the first edition appeared in 1920 and was produced with the object of incorporating oil engine experiences of the German Navy. Assistance in producing this book was given by the German Naval Department, and all the important German Diesel-engine builders, such as A. E. G., Benz, Daimler, Krupp - Germaniawerft, Görlitzer Maschinenbauan-stalt, Körting and the M. A. N. consented to the publication of drawings of their engines. This material has been brought up to date.

While, of course, the original purpose of these engines was for the propulsion of submarines this book indicates that the experience gained with this type of power is not lost because high-speed sets are now used in large numbers in Germany and elsewhere for general purposes, particularly for generating electricity. They have been found very advantageous for this purpose, especially where first-cost, weight and space occupied are important factors. Furthermore, high-speed engines seem to have a future because of the coming development of Diesel-electric drive.

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# Motorship "Fritzoe" Under Munson Line Flag

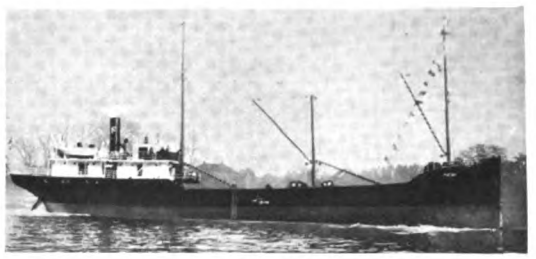
***Small Single-Screw Diesel-Driven Vessel Crossed Ocean and Engages in Semi-Coastwise Service — Consumed Only Thirty-six Tons of Fuel on Transatlantic Voyage***

ONE of the chief advantages of motorships as compared with steamships is the ability to go about the seas in either coastwise or ocean work, possessing the requisite cruising radius for any distance ocean voyages with the economy necessary for short coastwise runs. Especially is this advantage demonstrated in the smaller motorships, as in their case the margin between net cargo-capacity and deadweight - capacity is much greater than it is in the small steamer. The latter vessel cannot carry sufficient fuel for a long ocean voyage without greatly cutting into cargo-capacity, while in coastwise work the large fuel consumption, together with the smaller fuel-supply and short cruising-radius, often is too expensive to permit the small cargo-capacity to earn sufficient profit. In domestic shipping circles it is considered that oil-engine power is only economical on long distance trips, which is a misnomer.

Weighing the commercial and operating facts of an actual case, we are faced with a striking example of this superiority of the oil-engined vessel in the Norwegian motorship FRITZOE, which recently crossed the Atlantic to engage in off-shore work for an American shipowning company. She will be remembered as the 1,000 ton single-screw steel motorship built by the Nes Mekaniske Verksted, of Tonsberg, Norway, for Aktieselskabet Fritzoe, of Larvik, described and illustrated in our February, 1921 issue, and is of the following dimensions:

| | |
|---|---|
| Length, o.a. | 190′10½″ |
| Length, b.p | 179′ 6 ″ |
| Breadth, m.d. | 29′ 6 ″ |
| Depth, m.d. | 14′ 0 ″ |
| Gross tonnage | 667 tons |
| Deadweight capacity | 1,000 tons |
| Cubic cap. of holds (grain) | 51,290 cu. ft. |
| Cubic cap. of holds (bales) | 46,424 cu. ft. |
| Fuel capacity | 160 tons |
| Cruising radius | 19,200 miles |

She is propelled by a six-cylinder direct-reversible trunk-piston Burmeister & Wain Diesel-engine developing 450 brake h.p. at 145 r.p.m., the cylinders being 400 mm. (15.74″) bore and 750 mm. (29.52″) stroke. This engine is located in the aft end of the vessel together with the entire crew's quarters, leaving



**Munson Line's Danish-built motorship "Fritzoe"**

three-fourths of the length of the boat for cargo. Fuel-oil carried in the double-bottom is sufficient for 80 days' running at full-speed of 10 knots, her engine only consuming 2 tons (14 barrels) per day.

The FRITZOE was operated in the North Sea and Baltic trades for nearly two years and was recently purchased by the Munson Steamship Line of New York. This well-known ship-owning company now has in service two motorships—the FRITZOE and the MUNMOTOR, formerly the steamer COURTOIS—and a third, the COVEDALE, is being converted from steam to Diesel-power. Soon after the purchase of the FRITZOE she sailed from Bergen, Norway and made the run to Philadelphia in 18 days, burning only 36 tons of oil on the trip. In spite of extremely stormy weather on the trans-Atlantic voyage she ran without trouble or stop. Her holds were fully loaded with salt mackerel, in barrels, carrying on deck 455 barrels as well. Of these only three were lost overboard, indicating the good seagoing qualities of the ship.

Immediately upon arrival she entered the New York-West Indies service of the Munson Line, and already has made three round-voyages, carrying materials for the construction of a new hotel at Nassau, Bahamas, now being erected. Upon going on board the FRITZOE in New York recently, we found her under the command of Capt. B. Larssen and the engine-room in charge of Chief Engineer G. Jansen, both of whom have been with the ship since she went into commission. They are proud of their ship and her machinery, as they may well be, for she has never been delayed by engine trouble. The fuel used is Diesel-oil of about 24 deg. Baumé and Chief Engineer Jansen told us that he didn't know what engine - trouble was. The FRITZOE crossed the Atlantic, went down to Nassau and returned to New York without taking out exhaust-valves for grinding, which is extremely good service for steel valves.

In addition to her propelling-engine she has a single-cylinder B. & W. Diesel-engine driving a 33 k.w. dynamo and an air-compressor, this set being operated in port only, the electric current being used for operating the Titan electric - winches, anchor, windlass, lights, etc.; at sea a small generating-set furnishes current for lights. A small oil-fired donkey-boiler provides steam for heating the cabins. In our opinion the cabins should be heated by electricity, in preference to steam, as the donkey-boiler consumes more fuel than a Diesel-generating set would consume for this purpose. Her engineers are enthusiastic over the electric - driven deck auxiliaries, which operate satisfactorily. Another feature which could be improved is the steering of the vessel from outside on the bridge; in American craft of this type it is customary to steer from a protected position in the pilot-house.

A crew of 15 men handles this little craft, consisting of captain, two mates, steward, cook, chief engineer, second and third engineers, two oilers, and five sailors. Accommodations for the entire crew are aft, none being quartered forward as is customary in the small steamer. This improved accommodation for the crew is but another advantage of the motorship.

We commend the FRITZOE to the attention of American shipowners; many such craft should be in service on our coast. For many short coastwise runs such a vessel would prove far superior in every way to the small steamers now operating.

# New American Hvid-Type Oil-Engine

***The Bull-Dog Motor, Produced by Bates and Edmonds for Auxiliary Work***

THERE is no better indication of activity in the small oil-engine field than the entrance into this field of manufacturers who have until now not built marine oil-engines, following investigations of the business in prospect. Our pages have recently recorded many such instances. We have before us still another in the new engine manufactured by Bates & Edmonds Motor Co. of Lansing, Mich., who for many years have built gas-engines, hoists and pumps. This new "Bull-Dog" oil-engine is of the four-cycle type operating on the Hvid principle. In this system fuel is drawn into a small cup or combustion-chamber during the suction-stroke, being here ignited by the heat of compression, partial combustion taking place, the gases being blown into the cylinder by the pressure of its own combustion.

Built in single-cylinder 6 h.p. and double-cylinder 12 h.p. units, this power is developed at 540 r.p.m., the cylinder sizes being 4¾″ bore and 8″ stroke. In the single-cylinder engine the upper half of the base and the cylinder are cast together and bolted to the lower-base at the center-line of the crank-shaft. Cylinders of the 12 h.p. engine are cast individually with separate cylinder-heads. In the head are located mechanically-operated valves, which are enclosed by a removable cover. All moving parts except the flywheel are enclosed, but large hand-hole plates provide access to them. Starting is effected by turning the engine over by crank applied to the flywheel, which is on the forward end of the engine. There are no electric ignition or starting devices or torches.

Regulation of the fuel is obtained through a governor operating on a needle-valve which admits the proper quantity of oil for the load on the engine at all powers. Fuel sufficient for 12 hours' operation is contained in a compartment in the base, being raised to the fuel-valve by a plunger-pump which is submerged in the fuel. All moving parts are flooded with oil by a plunger-pump which, as well as the fuel-pump, operates at low pressure and requires no packing. All bearings, which have babbitt liners and which are supported by the lower base independent of the upper base, are of ample size, bearing pressures being reduced to a minimum. The crankshaft throws are counter-balanced; all bearings are readily accessible and renewable through large hand-holes in the base.

Starting from cold is accomplished immediately on the oil on which the engine operates, this being any oil of the gravity of kerosene or slightly lower grade of oil. A fuel-consumption of not over 0.6 lbs. per h.p. hour is realized with this engine. The engine will not operate on gasoline. For driving various auxiliary electric-generating sets, air-compressor sets, pumps, hoists, ice-machines, etc., this oil-engine is well suited. There is also a growing tendency to use such small oil-engines in the work-boat field, where the cost of operating small passenger launches, ship-chandlers' delivery boats, mail-boats, etc., on gasoline fuel is prohibitive. And for small pleasure boats such engines are also well fitted.

### A NEW ALASKAN BOAT

A 45 h.p. Fairbanks Morse oil-engine is being installed in the new passenger-and-mail-boat GEORGE JR., which will be operated in Alaska. She is owned by George Ramstead of Juno, Alaska, and the work is being done at the Ballard Marine Railway, Seattle.

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# Engine-Room Log of a Big American Motorship

## *Complete Record of Twelve Months' Operation of the Shipping Board's Diesel-Driven Freighter "William Penn" Covering Two Round-the-World Voyages*

WHEN the motorship WILLIAM PENN called at Shanghai, China, several American and English business men visited the ship, having with them a copy of the May issue of MOTORSHIP in which was described the first round-the-world voyage of the WILLIAM PENN. They immediately sought Chief-Engineer Olson who relates to us that they were particularly anxious to find out if all that was said in "MOTORSHIP" about the remarkable performance was true. When Chief Engineer Olson assured them that the complete article and data was correct as given in "MOTORSHIP" they were naturally exceedingly pleased that an American motorship had made such a voyage, and particularly gratified that in far-off China they could, thro' "MOTORSHIP," keep in touch with progress in the motorship field and be certain that what they read was reliable.

**THE CHIEF-ENGINEER'S REPORT TO THE U. S. SHIPPING BOARD:**
**MOTORSHIP "WILLIAM PENN"**

*At sea from Singapore to Marseilles, August 8th, 1922.* First annual report covering condition of machinery, overhaul, repairs, and suggestions for improvements. The ship was commissioned June 23rd, 1921, but owing to certain alterations to the hull, and lack of freight, she never went to loading berth until August 8th, 1921. My report, therefore, will begin from the latter date.

The ship is now on the second round of the world voyage, carrying the fourth full cargo, and has traveled a total distance of 44,781 knots up to midnight August 7th, 1922.

OSCAR OLSON, *Chief Engineer.*

STARBOARD MAIN-ENGINE

The fuel and exhaust valves on this engine have been changed three times and valves that were replaced have been overhauled and put in good condition.

All air-intake valves and all starting valves have been lifted out once for examination, cleaning, and where necessary ground in; two studs for intake valves have also been replaced.

Nos. 1-2-4-5 pistons have been lifted and piston-rings renewed, cylinders were trammed and showed no wear, cylinder walls were very smooth and nicely polished.

Telescope tubes for the piston cooling-water show slight signs of wear and have been packed seven times.

Clearances have been taken of all cross-head bearings, as well as Nos. 1 and 6 crankpin bearings; all clearances remaining practically the same as when leaving the builders.

Nos. 1 and 8 main bearings lifted for examination and bridge gauge applied, alignment of shaft same as when leaving the builders, and bearings in very good condition.

Gears for driving the camshaft have been closely examined from time to time and show no sign of wear whatsoever.

All valves in all three stages of the air-compressor have been changed six times and all valves that were replaced have been overhauled and put in good condition.

Air coolers have been examined for oil, found clean and in good condition.

Fuel-pump plungers have been changed once, old plungers to be overhauled, fuel-pump valves and check valves on fuel-oil line have been ground in three times and fuel-pump plungers have been packed five times.

Thrust-bearing is in very good condition and no adjustments to same have been necessary.

Turning-gear in good condition and giving excellent service. On March 25th, 1922, the ship was in dry-dock, the stern-tube was repacked and clearance taken between stern-tube and top of tailshaft at outboard end (clearance 3/32").

PORT MAIN-ENGINE

The fuel and exhaust valves on this engine have been changed three times and valves that were replaced have been overhauled and put in good condition.

All air intake and starting valves have been lifted out once for examination, cleaning, and where necessary ground in; two studs for intake valves were also replaced.

No. 2 piston has been lifted and piston-rings renewed; cylinder was in fine condition and showed no sign of wear.

Telescope tubes for piston cooling-water show slight signs of wear and all have been packed seven times.

Clearances have been taken of all cross-head bearings, as well as Nos. 1 and 6 crankpin bearing; all clearances practically the same as when leaving the builders.

Nos. 1 and 8 main bearings lifted for examination and bridge gauge applied; alignment of shaft same as when leaving the builders, and bearings in very good condition.

Gears for driving the cam-shaft have been closely examined from time to time and show no sign of wear, whatsoever.

Air-compressor head was lifted for making new joint under same, cylinders and pistons were cleaned and one ring on first stage, two rings on the second stage and three rings on the third stage pistons renewed, all valves in all three stages have been changed six times and all valves that have been replaced have been overhauled and put in good condition.

Air coolers have been examined for oil, found clean and in good condition.

Never before has such a complete verbatim log report of a motorship been published, so the following will be read with considerable interest. It will do much to convince shipowners of the accuracy of the many previous articles in this magazine on the voyages of this and other motorships. For permission to publish the log we are indebted to the courtesy of the U. S. Shipping Board.

Fuel-pump plungers have been changed once, old plungers to be overhauled, fuel-pump valves and check valves on fuel-oil line have been ground in three times and fuel-pump plungers have been packed five times.

Thrust bearing is in very good condition and no adjustments to same have been necessary.

Turning gear in good condition and giving very good service.

On March 25th, 1922, while ship was in dry-dock, the stern-tube was repacked and clearance taken between stern-tube and top of tailshaft at outboard end (clearance 3/32"). Tip of one propeller blade which was bent, was straightened to its original shape.

All sea valves were examined and repacked, all found in good condition; two coats of non-corrosive paint were applied to strainers and valve boxes.

Foundations for both main engines, as well as all auxiliary foundations in good condition and have shown no sign of weakness.

NO. 1 AUXILIARY ENGINE

The pistons have been lifted for examination, found all rings free and in good condition, cylinders very smooth and showed hardly any signs of wear at all. Cylinder liner for forward cylinder was lifted and new joint made at bottom of same.

Piston clearances, as well as clearances of all bearings, have been taken, and found the same as when leaving the builders.

This engine is in operation from five to six hundred hours when all valves on engine and compressor are changed with spare set and old valves are immediately overhauled and made ready for another engine. This engine is in good condition and has at all times given good service.

NO. 2 AUXILIARY ENGINE

The only work on this engine, outside of periodically changing the valves, has been to replace the fuel-pump plunger and pack same; this engine is in good condition and has at all times given good service.

NO. 3 AUXILIARY ENGINE

This engine, after being in operation for seventeen hundred hours, was dismantled for examination, both pistons and air-compressor pistons were lifted, all rings were free and in good condition.

Cylinders were trammed and showed no wear; cylinder walls very smooth and nicely polished; all bearings were lifted out for examination and leads taken of same; all clearances found the same as when leaving the builders. All valves on this engine are periodically changed same as on No. 1.

The generators which are direct-connected to each engine are in first-class condition and have required no renewal of parts or repairs of any kind.

MANEUVERING COMPRESSOR

Cylinders, pistons and valves examined and found in first-class condition; electric motors and control in good condition and have given good service at all times.

TWO LUBRICATING OIL PUMPS

These pumps are in good condition and have required no renewals of parts and have had no repairs, except cleaning of ball bearings for motors.

SALT WATER COOLING PUMPS

No. 1 pump in good condition, no renewals of parts and no repairs, except cleaning of ball bearings for motor, and once that the pump has been repacked.

No. 2 pump had three coils come loose in armature of motor; the defective armature has been replaced with spare, pump has been packed twice and ball bearings for motor examined and cleaned; motor and pump now in good condition.

No. 3 pump in good condition, no renewals of parts and no repairs, except packing the pump and cleaning ball bearings for motor.

| Departed From | Date | Mean Draft | Arrived At | Date | Mean Draft | Dist. by Observ. | Dist. by Engines | Slip | Running Time D. H. M. | R.P.M. | Speed in Knots | Average I.H.P. | Fuel (Bbls. per Day) | Lb. per I.H.P. Hour | Nautical Miles per Bbl. of Fuel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| New York | April 22 | 28′ 8″ | Norfolk | April 23 | 28′ 8″ | 246 | 269 | 8.5 | 0-21-20 | 109.1 | 11.55 | 4,370 | 102 | 0.310 | 2.7 |
| Norfolk | April 24 | 29′ 2″ | Panama | May 1 | 29′ 0″ | 1,769 | 2,003 | 11.6 | 6-11-40 | 111 | 11.4 | 4,413 | 101 | 0.302 | 2.7 |
| Panama | May 1 | 29′ 0″ | Honolulu | May 18 | 28′ 3″ | 4,718 | 5,276 | 10.5 | 17- 5-20 | 110 | 11.4 | 4,347 | 98.4 | 0.296 | 2.7 |
| Honolulu | May 22 | 28′ 10″ | Yokohama | June 5 | 28′ 10½″ | 3,449 | 3,965 | 13. | 13-11-31 | 105.7 | 10.66 | 4,066 | 91.4 | 0.291 | 2.8 |
| Yokohama | June 15 | 21′ 1″ | Kobe | June 16 | 21′ 1″ | 360 | 385 | 6.5 | 1- 6-21 | 109.5 | 11.09 | 4,260 | 93.6 | 0.290 | 3. |
| Kobe | June 22 | 15′ 1″ | Shanghai | June 25 | 15′ 3″ | 788 | 890 | 11.4 | 2-21-28 | 110.5 | 11.35 | 4,200 | 93.6 | 0.297 | 2.9 |
| Shanghai | July 1 | 12′ 4″ | Hong Kong | July 4 | 12′ 1″ | 771 | 954 | 19.1 | 3- 1-13 | 112.4 | 10.53 | 3,950 | 88. | 0.288 | 2.8 |
| Hong Kong | July 5 | 11′ 9″ | Manila | July 7 | 11′ 9″ | 636 | 724 | 12.1 | 2- 9-57 | 107.9 | 11. | 3,780 | 81.6 | 0.280 | 3.2 |
| Manila | July 14 | 16′ 9″ | Cebu | July 16 | 16′ 9″ | 393 | 413 | 4.8 | 1- 9-56 | 104.7 | 11.5 | Various | ..... | ..... | .... |
| Cebu | July 19 | 18′ 1″ | Singapore | July 24 | 18′ 3″ | 1,349 | 1,515 | 11.2 | 5- 2-47 | 106.4 | 11. | 4,145 | 90.3 | 0.282 | 2.9 |
| Singapore | Aug. 2 | 22′ 10″ | Port Said | Aug. 23 | 22′ 1″ | 4,960 | 6,020 | 17.6 | 21-20-51 | 103.2 | 9.87 | 4,130 | 90. | 0.281 | 2.6 |
| Port Said | Aug. 24 | 22′ 1″ | Marseilles | Aug. 29 | 21′ 11½″ | 1,523 | 1,725 | 12. | 5-16-29 | 108.9 | 11.1 | 4,260 | 92.7 | 0.282 | 2.87 |
| Marseilles | Sept. 1 | 21′ 0″ | Bilbao | Sept. 7 | 20′ 10½″ | 1,571 | 1,829 | 14.1 | 6- 0-50 | 108.9 | 10.84 | 4,280 | 96. | 0.296 | 2.71 |
| Bilbao | Sept. 8 | 20′ 2″ | London | Sept. 11 | 20′ 1″ | 611 | 702 | 12.9 | 2- 8-20 | 107.5 | 10.9 | 4,280 | 96. | 0.291 | 2.7 |
| London | Sept. 13 | 18′ 7″ | Hamburg | Sept. 14 | 18′ 5″ | 302 | 334 | 8.3 | 1- 2-12 | 109.9 | 11.7 | 4,360 | 97. | 0.289 | 2.92 |
| Hamburg | Sept. 26 | 14′ 1″ | New York | Oct. 9 | 14′ 6″ | 3,532 | 4,170 | 14. | 13-12-20 | 109.4 | 10.9 | 4,330 | 97. | 0.295 | 2.72 |

Extract of Log of Motorship WILLIAM PENN for Second World-Voyage. The story of the trip was given in our November number

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FRESH WATER COOLING PUMP

Motor and pump in good condition and have required no renewals of parts nor any repairs, except cleaning of ball bearings for the motor.

BILGE AND SANITARY PUMPS

No. 1 pump plungers have been packed twice, suction and discharge valves ground in three times and five studs for same have been renewed, no renewals of parts for motor and no repairs. Motor and pump in first-class condition.

No. 2 pump plungers have been packed twice, suction and discharge valves ground in four times, and four studs for same have been renewed; no renewals of parts for motor, and no repairs to same. Motor and pump in first-class condition.

BALLAST PUMP.

This pump has only been used eight hours, at which time it gave very good service; motor and pump in good condition.

FUEL TRANSFER PUMP.

Pump has been packed once, otherwise there have been no renewals or repairs to either pump or motor; both in good condition.

FRESH WATER PUMP.

Motor and pump in good condition, no renewals of parts and no repairs.

MOTOR-GENERATING SET.

Both motor and generator in good condition, no renewal of parts, and no repairs.

REFRIGERATING ENGINE.

Motor and refrigerating engine in good condition, and have been giving the best of service at all times; there have been no renewals of parts to either.

ENGINE ROOM.

The engine-room and ice-machine room have been scrubbed and painted once from top to bottom, tank-tops and bilges in engine-room cleaned and washed out several times.

WINDLASS.

Outside of a slight adjustment to the magnetic brake, there have been no repairs to this machine, nor any renewal of parts. Machine in good condition, and giving very good service.

MOORING-WINCH ON POOP DECK.

While mooring ship at Tilbury Dock, London, last voyage, too great a strain was put on the cable, causing outboard bearing bracket to give away, also breaking the shaft coupling; the above damage was repaired upon the ship's arrival at New York.

The control for this machine was designed, and is of the same type as the controllers for the deck winches, and unfortunately no one thought of it until after the ship was commissioned, and someone undertook to haul the ship into the dock with the maneuvering handle in lowering position. The deck officer in charge was then instructed how to operate same, and all went along very nicely, until the next time it was used, when the above-mentioned mistake was repeated, but this time of a longer duration, which caused the resistors R3 and R4 to burn out, leaving the winch only running one way, for hoisting only, which is the proper way. However, we have again made the winch reversible, and it is in good condition and giving good service. I admit it is not the proper control for a mooring winch, but with correct and careful operation it can be made to answer the purpose very well.

STEERING-GEAR.

Steering gear, including motor, pump, hydraulic rams, and telemotor, are in good condition and giving good service, and have required no renewal of parts, nor any repairs.

As this gear is a new departure from the old steam gear, it naturally makes a good many people skeptical in regard to its stable operation, but I must say in all fairness to the builders, that so far it has proven to be absolutely reliable and seaworthy.

DECK WINCHES.

We have experienced a few minor troubles with the winches at various times, which altogether have caused a few hours' delay in the handling of cargo. The winch motors are very rugged and stand up remarkably well under the most severe conditions, the controllers are very durable and give good service; the trouble which has caused the delay are the resistors, owing to the inaccessible way of locating the trouble inside the resistor boxes, which may be of a small nature, such as insulating trouble with one of the wires, and which could be repaired in a few minutes if it were accessible.

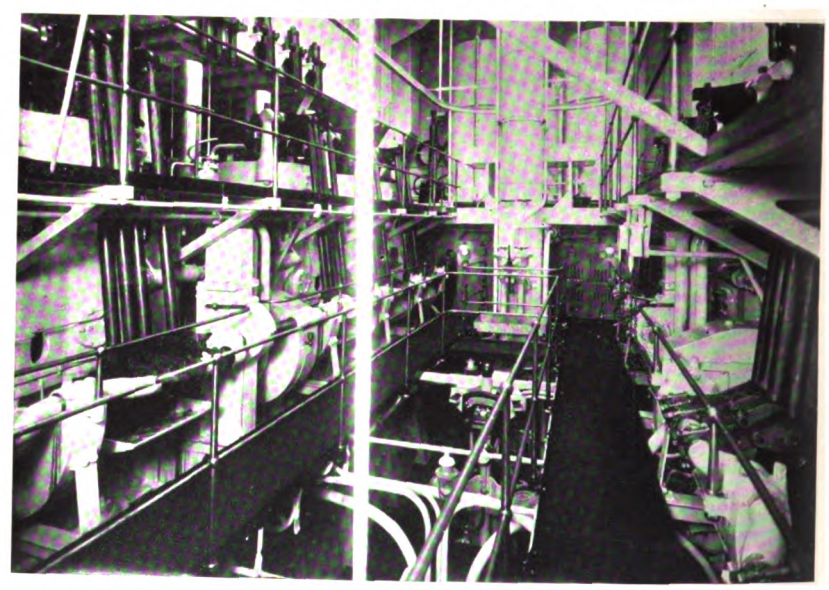
# Third Wilhelmsen Motorship Runs Trials

## *Burmeister & Wain Complete New Diesel-Driven Freighter "Tennessee"*

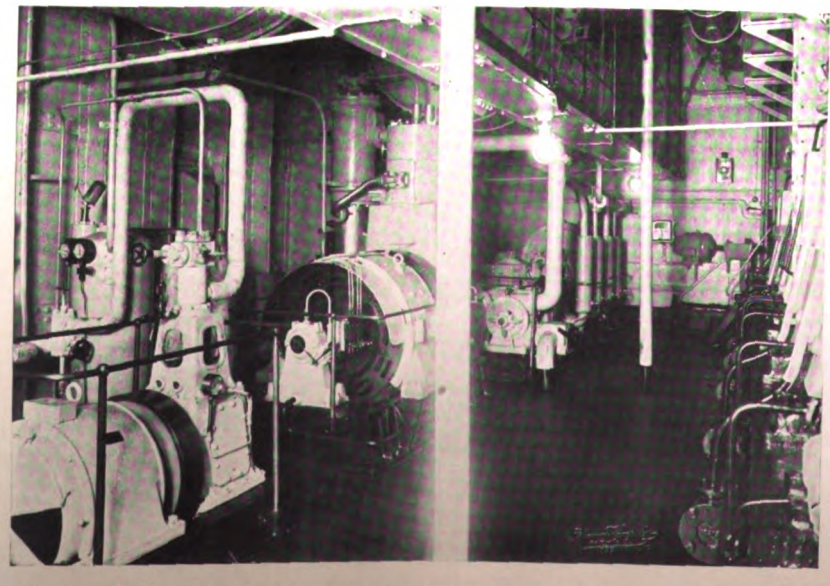
REGARDLESS of the tremendous slump in steamship construction, motorship building still continues on the increase in Europe over pre-war development. Wm. Wilhelmsen of Christiania, Norway, which has some association with the Kerr Steamship Co. of New York, has just taken delivery of his third motorship from Burmeister & Wain, Copenhagen. The latest vessel, the TENNESSEE, is of 14,995 tons loaded-displacement, 10,875 tons d.w.c. and has a loaded-speed of 11¼ knots on a daily fuel-consumption of 10 tons. She is propelled by twin 1,550 i.h.p. (1,200 shaft h.p.) B. & W. Diesel engines. Trials were run on Sept. 28th, when a speed of 12.5 knots was averaged with the engines running at 144.25 r.p.m., together developing 3,640 i.h.p.

Fuel used was of 18,274 b.t.u. On speed trials over the mile the displacement was 4,415 tons. The consumption figured out at 0.298 lb. per i.h. p. hour. The TENNESSEE is a sister motorship to the THALATTA and TENERIFFA previously described in this publication.

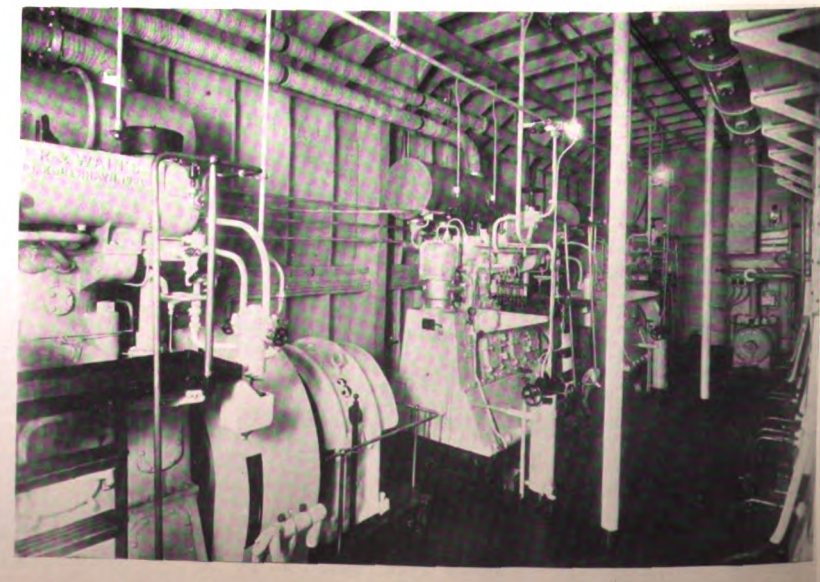
The "Tennessee on trials



General view of engine-room



Starboard side of engine-room showing refrigerator, auxiliary-compressor, etc.



The three auxiliary B. & W. Diesel-driven generating-units on port side

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### OIL-ENGINED WORK-BOATS IN FLORIDA

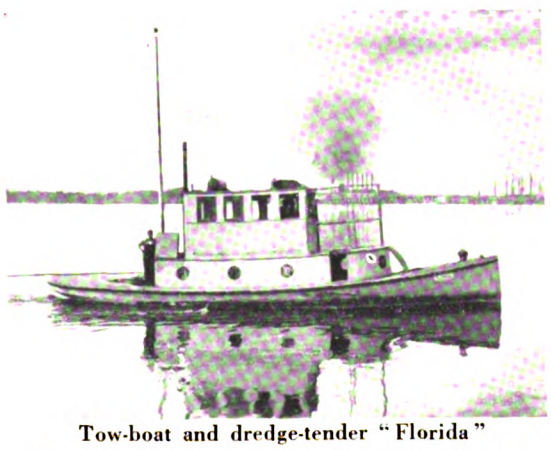
OIL-ENGINES have gained a strong foothold in the Southland and on page 837 of our November issue reference was made to some installations. We are now enabled to illustrate several of these craft and their general business-like appearance will be noted. As shallow, smooth, inland-water service is the daily work of these craft it will also be seen that they are universally of quite low freeboard with spacious deckhouses added to accommodate machinery and cargo. We commend the general character of these craft to the attention of boat builders and operators in sections of the country where similar conditions prevail.

The "Katie S." of Jacksonville

Three Jacksonville motor-freight-boats (reading left to right): "Alamo," "Indian" and "Daytona"

The ECHO is a unique example of a tunnel-stern freighter for operating in shallow waters; she is of square-ended model 65 ft. long, 18 ft. breadth and 3 ft. light draft, or 4 ft. when loaded with 50 tons of cargo. Smith & Bowen of Jacksonville operate this boat between that city and West Palm Beach. Her power plant is a 60 h.p. Fairbanks-Morse oil-engine.

Shoal-draft freighter "Echo"



Tow-boat and dredge-tender "Florida"

Two freight-boats owned by the Jacksonville-Daytona Boat Line, the DAYTONA and the INDIAN, illustrated lying at their dock in Jacksonville, together with the ALAMO, which is owned by the Jacksonville-St. Augustine Day Line. The latter is equipped with a 60 h.p. Fairbanks-Morse engine, while the DAYTONA, which has a 45 h.p. engine of the same make, is 65 ft. long, 20 ft. breadth, 3 ft. 6 in. light draft and 5 ft. loaded draft with 60 tons of cargo. She was built by Olson at Dames Point, 12 miles from Jacksonville, and went into service in August of this year. A 30 h.p. Fairbanks-Morse engine has propelled the INDIAN since she went into service two years ago.

In the FLORIDA we have a typical example of Southern dredge-tender and tug. She is owned by W. T. Coppedge, who selected a 60 h.p. Fairbanks-Morse oil-engine to propel her. Such a tug, with hinged or lower mast, would prove an excellent and economical type of tug-boat for use on canals, so far as general design is concerned, the power being proportioned to the work to be done.

Another such craft which might well be studied as a type of tug and cargo-craft of moderate size is the KATIE S, designed and owned by Geo. W. Spaulding, one of the Bar pilots at the St. Johns Bar. She is 64 ft. long, 18 ft. 6 in. breadth and 4 ft. 6 in. draft, and was built by Edward S. Thibault of Jacksonville. Her 60 h.p. Fairbanks-Morse oil-engine propels her at economical speed in coastwise runs.

### LLOYD'S ANNUAL SHIPPING REPORT

In the recent quarterly reports of Lloyds Register of Shipping figures have been given concerning the growth of motorships in the merchant marine, but the latest annual report is even more lucid on the subject. The following figures appear in the report:

The total number of vessels built to class during 1921 and fitted with oil-engines was 59, of 226,404 tons, 21 of which were ships of large size totaling 168,476 gross tons. All these vessels were fitted with engines using heavy oil.

Motorships recorded in register book:

| | No. | Gross Tons |
|---|---|---|
| July, 1914 | 297 | 234,287 |
| July, 1919 | 912 | 752 606 |
| July, 1920 | 1,178 | 955,810 |
| July, 1921 | 1,473 | 1,248,800 |
| July, 1922 | 1,620 | 1,542,160 |

Of the 1,620 motor-vessels mentioned in the above table for the current year, 341 are of 1,000 tons and upwards. Of these, 130 have tonnages ranging from 1,000 to 2,000 tons; 98 are from 2,001 to 4,000 tons; 47 from 4,001 to 6,000 tons; and 66 are above 6,000 tons. Sixty-four of the large motorships are of the single-screw class.

Nearly one-half of the smaller vessels depend solely on their engines for their motive power. Amongst the 341 vessels of 1,000 tons and above, 93 are provided with considerable sail power, and are recorded in the Register Book as "Auxiliaries." Of these

13 are from 1,000—1,300 tons.
19 are from 1,301—1,500 tons.
29 are from 1,501—1,800 tons.
12 are from 1,801—2,000 tons.
20 are above 2,000 tons.

Of the types of Diesel engines fitted, the four-cycle predominates in numbers and total horsepower; but the two-cycle type is well represented, and some opposed-piston oil engines have also been fitted. Some double-acting Diesel engines are under construction.

A set of "Still" engines, which are a combination of oil and steam engines, is at present under construction. The specified total brake horsepower of these engines is 2,500, and they are intended to be fitted in a twin-screw vessel of 450 feet length.

### O'HARA BROS.' THIRD BOLINDER-ENGINED SCHOONER

O'Hara Bros.' new auxiliary fishing schooner "Lark," powered with a 175 b.h.p. Bolinder engine

On October 8th at the conclusion of her trial-trip the new schooner LARK was added to the fishing fleet of O'Hara Bros. of Boston. This company already own and operate the schooners PIONEER and MARY E. O'HARA, both powered with Bolinder oil-engines as is the LARK. This latest addition to the fleet, illustrated on her trial trip, is of the following dimensions:

| | |
|---|---|
| Length (o. a.) | 129 ft. |
| Length (w. l.) | 115 ft. |
| Breadth (m. s.) | 25 ft. |
| Draft | 11 ft. |
| Tonnage | 150 tons gross |
| Power | 175 h.p. |

Richard Diebold of Newcastle, Me., built the LARK, which came to Gloucester for fitting out. On her trials her two-cylinder 175 h.p. direct-resersible Bolinder engine drove her against a strong breeze at 8½ knots with a 66″x60″ Columbian bronze propeller turning up 195 r.p.m. She made the run from Gloucester to Boston, 32 miles, in 3 hrs., 15 min. under power alone and during her first trip to the fishing banks attained a speed of nearly 12 knots under both sail and power. She carries a fuel-tank of 3,000 gallons, this being of 3-16 in. galvanized iron, a lubricating-oil tank of 270 gallons, which gives her a radius of action on this supply of 10 days at full power, the consumption of fuel and of lubricating-oil per hour being 12 gallons and one-quarter gallon respectively. Electric lights are provided by a 5 h.p. gasoline-engine driven set which also operates the bilge pump.

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# Selecting the Best Propelling Machinery

***Extract of Paper Read Before the American Society of Naval Architects and Marine Engineers by J. L. Ackerson, Vice-President, Merchants Shipbuilding Co., Nov. 9, 1922***

NEVER before has the marine-engineering fraternity had so many different types of propelling machinery to select from, and there is no empirical formula which can be applied to help select the best type. The problem of the shipowner in this respect is the most important one he has today. Amongst the many factors to be considered in deciding what is the most suitable type are reliability (this is the most important single factor, for without reliability other advantages are very much discounted), economy in operation, initial cost, and weight, the relative importance of the last three depending on the type of ship under consideration.

Numerous papers have been presented at these meetings, practically all of them having been prepared by the shipbuilder—and they are thoroughly prepared, too; but there must be many factors that the shipowner is more familiar with than the shipbuilder, and it would be very interesting to hear from the shipowner his ideas on this matter.

Reliability is something less tangible than the other three and responsibility less easily placed, because the factors controlling reliability emanate from two different sources: (1) the owner through the selecting of competent personnel; and (2) the builder. No matter how well a machine has been designed and constructed, if placed in the hands of an incompetent operator it will become unreliable; and *vice versa*, no matter how good the operating engineer, if the proper factors have not been used in the design and care in the construction, then the machinery is again unreliable; so that it is absolutely necessary for the operator to thoroughly understand and be whole-heartedly in support of any new design, and for the designer to realize that the cost of fuel per horse-power, while important, is not the only consideration. In the past five years we have had a very costly experience through sending to sea a large number of units (the design of which to begin with is questionable) in charge of engineers who were only half trained.

Economy in operation (that is, the fuel per horse-power) and initial cost usually bear a very close relation to each other, and it is only a question of figures to determine whether any particular type is worth the money as compared with any other type; and here again the type of vessel and the trade the vessel is employed in play an all-important part, as, for example, most tramp steamers over a cycle of, say, seven years are laid up for considerable periods at a time owing to there being no freight. During this lay-up the portion of expense due to fixed charges is going on all the time, while that portion consisting of fuel and supplies and operating personnel stops when the ship is laid up.

Weight is the least important except in the case of special types like shallow-draught boats, express-type steamers, warships, etc., because except in special trade—viz., coal, ore or oil-carrying—it is seldom that a ship is loaded down to a loaded draught mark, even when full of cargo.

With this brief introduction I will now present comparisons of the following different types of machinery and ships:

Geared turbines with Scotch boilers.

Geared turbines with watertube boilers.

Reciprocating steam-engines with Scotch boilers.

Reciprocating steam-engines with watertube boilers.

Diesel engine 4-cycle.

Diesel engine 2-cycle.

For 5,000-ton freighter at 10½ knots.

For 7,500-ton freighter at 11 knots.

For 8,800-ton freighter at 10½ knots.

For 10,000-ton freighter at 12½ knots.

For 10,500-ton tanker at 10½ knots.

For 17,000-ton displacement passenger ship at 15 knots.

From Plate 1 the one outstanding feature is the greater savings for Diesel-engine ships in the long-voyage trades, and this is chiefly due to the saving of cargo space required for carrying fuel-oil rather than to the saving in cost of fuel-oil, operating personnel, and fixed charges. Also, that for short voyages the Diesel-engine should be given very careful consideration before a selection of the type to be used is made.

The different comparisons show that there is not much difference between the weight of Diesel engines and steam reciprocating engines, but it should be borne in mind that for steamers up to 12 knots speed the revolutions per minute of the Diesel engine are considerably higher than those of the corresponding steam engines—in the ratio of about 110 to 75. This undoubtedly means a less efficient propeller for all single-screw types. On faster boats the advantages of the slower revolutions per minute gradually disappear. In comparing weights, allowance should be made for reserve feed water for the steamer; if this is done, steam-engine weights will invariably be greater than Diesel-engine weights for voyages of ten days and over, except in the case of larger power geared-turbine jobs than those now under consideration.

It should also be noted that, whereas powers of four to five thousand are possible on single-screw steam installations, it is necessary to go to twin-screw installations for Diesel engines. This incurs an extra cost in hull construction, necessitating two shaft alleys which cut up the after holds and make it more difficult to stow cargo, as well as actually decreasing the cubic of the holds.

Originally it was my intention to resolve the saving in cargo space due to fuel-oil requirements into dollars per year, but owing to the uncertainty of freight rates I gave up the idea as being impracticable and have shown this advantage in tons per voyage. The alternative to carrying this large quantity of fuel-oil would be to buy it at the ports of call. Which choice would be the better would depend, of course, on the price of the fuel-oil at, and the freight rate to, those particular ports.

The initial costs listed in Plate 1 may be open to criticism, owing to prices being so spotty and varied at the present time. These prices are based on firm quotations of the lowest reputable bidder and include machinery installed ready for use. The same remark applies to weight. Different builders vary considerably, but, whatever error there is, the percentage of error will be the same for all types and will be in the same direction; and as it is the difference in cost and the difference in weight which we are most interested in, the percentage of error will be very small.

| Type of Ship | | Machinery: Type | Weight | Initial Cost | Cost of Fuel at Sea: Per Day | 200 D. at Sea | Cost of Fuel Per Year: In Port | Total | Cost of Operating Personn. | Depreciation Chrgs. 15% | Total Cost Per Annum | Feed Water Make Up per Day | Fuel Oil Required for Following Distances Allowing 15% Margin: 5,000 M. | 10,000 M. | 15,000 M. | 20,000 M. | Inner Bottom Tank Capacity | Cargo Space Taken Up for Fuel Oil for Following Distances: 5,000 M. | 10,000 M. | 15,000 M. | 20,000 M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5,000 Ton Freighter 10½ Knots Single Screw | 1650 I.H.P. | R.E. & S.B. | 380 ton | $167,000 | 22 ton, $220 | $44,000 | $1,650 | $45,650 | $13,920 | $25,000 | $84,570 | 6 ton | 440 ton | 880 ton | 1,320 ton | 1,760 ton | 680 ton | 0 | 200 ton | 640 ton | 1,080 ton |
| | | R.E. & W.T.B. | 316 ton | 163,000 | 22 ton, $220 | 44,000 | 1,650 | 45,650 | 13,920 | 24,500 | 84,070 | 6 ton | 440 ton | 880 ton | 1,320 ton | 1,760 ton | Above Feed Water Requirement | 0 | 200 ton | 640 ton | 1,080 ton |
| | | G.T. & S.B. | 355 ton | 175,750 | 22 ton, $220 | 44,000 | 1,650 | 45,650 | 13,920 | 26,400 | 85,970 | 6 ton | 440 ton | 880 ton | 1,320 ton | 1,760 ton | | 0 | 200 ton | 640 ton | 1,080 ton |
| | 1500 S.H.P. | G.T. & W.T.B. | 291 ton | 171,000 | 22 ton, $220 | 44,000 | 1,650 | 45,650 | 13,920 | 25,600 | 85,170 | 6 ton | 440 ton | 880 ton | 1,320 ton | 1,760 ton | | 0 | 200 ton | 640 ton | 1,080 ton |
| | | 4 Cycle Diesel | 400 ton | 207,000 | 7¼ ton, $84 | 16,800 | 495 | 17,295 | 12,360 | 31,000 | 60,655 | 0 | 145 ton | 290 ton | 435 ton | 580 ton | ..... | 0 | 0 | 0 | 0 |
| | | 2 Cycle Diesel | 350 ton | 222,000 | 7¼ ton, $84 | 16,800 | 495 | 17,295 | 12,360 | 32,000 | 62,855 | 0 | 145 ton | 290 ton | 435 ton | 580 ton | ..... | 0 | 0 | 0 | 0 |
| 7800 Ton Freighter 11 Knots Single Screw | 2700 I.H.P. | R.E. & S.B. | 625 ton | 230,000 | 34 ton, $340 | 68,000 | 1,650 | 69,650 | 14,280 | 34,500 | 118,430 | 8 ton | 650 ton | 1,300 ton | 1,950 ton | 2,600 ton | 1,038 ton | 0 | 262 ton | 912 ton | 1,562 ton |
| | | R.E. & W.T.B. | 538 ton | 224,000 | 34 ton, $340 | 68,000 | 1,650 | 69,650 | 14,280 | 33,600 | 117,530 | 8 ton | 650 ton | 1,300 ton | 1,950 ton | 2,600 ton | Above Feed Water Requirement | 0 | 262 ton | 912 ton | 1,562 ton |
| | | G.T. & S.B. | 570 ton | 244,000 | 34 ton, $340 | 68,000 | 1,650 | 69,650 | 14,280 | 36,600 | 120,530 | 8 ton | 650 ton | 1,300 ton | 1,950 ton | 2,600 ton | | 0 | 262 ton | 912 ton | 1,562 ton |
| | 2500 S.H.P. | G.T. & W.T.B. | 483 ton | 239,000 | 34 ton, $340 | 68,000 | 1,650 | 69,550 | 14,280 | 35,800 | 119,730 | 8 ton | 650 ton | 1,300 ton | 1,950 ton | 2,600 ton | | 0 | 262 ton | 912 ton | 1,562 ton |
| | | 4 Cycle Diesel | 650 ton | 307,000 | 11 ton, $130 | 26,000 | 490 | 26,490 | 12,720 | 46,000 | 85,210 | 0 | 210 ton | 420 ton | 630 ton | 840 ton | ..... | 0 | 0 | 0 | 0 |
| | | 2 Cycle Diesel | 540 ton | 327,000 | 11 ton, $130 | 26,000 | 490 | 26,490 | 12,720 | 49,000 | 88,210 | 0 | 210 ton | 420 ton | 630 ton | 840 ton | ..... | 0 | 0 | 0 | 0 |
| 8200 Ton Freighter 10½ Knots Single Screw | 2700 I.H.P. | R.E. & S.B. | 625 ton | 230,000 | 34 ton, $340 | 68,000 | 1,650 | 69,650 | 14,280 | 34,500 | 118,430 | 8 ton | 680 ton | 1,360 ton | 2,040 ton | 2,720 ton | 1,140 ton | 0 | 220 ton | 900 ton | 1,580 ton |
| | | R.E. & W.T.B. | 538 ton | 224,000 | 34 ton, $340 | 68,000 | 1,650 | 69,650 | 14,280 | 33,600 | 117,530 | 8 ton | 680 ton | 1,360 ton | 2,040 ton | 2,720 ton | Above Feed Water Requirement | 0 | 220 ton | 900 ton | 1,580 ton |
| | | G.T. & S.B. | 570 ton | 244,000 | 34 ton, $340 | 68,000 | 1,650 | 69,650 | 14,280 | 36,600 | 120,530 | 8 ton | 680 ton | 1,360 ton | 2,040 ton | 2,720 ton | | 0 | 220 ton | 900 ton | 1,580 ton |
| | 2500 S.H.P. | G.T. & W.T.B. | 483 ton | 239,000 | 34 ton, $340 | 68,000 | 1,650 | 69,650 | 14,280 | 35,800 | 119,730 | 8 ton | 680 ton | 1,360 ton | 2,040 ton | 2,720 ton | | 0 | 220 ton | 900 ton | 1,580 ton |
| | | 4 Cycle Diesel | 650 ton | 307,000 | 11 ton, $130 | 26,000 | 490 | 26,490 | 12,720 | 46,000 | 85,210 | 0 | 220 ton | 440 ton | 660 ton | 880 ton | ..... | 0 | 0 | 0 | 0 |
| | | 2 Cycle Diesel | 540 ton | 327,000 | 11 ton, $130 | 26,000 | 490 | 26,490 | 12,720 | 49,000 | 88,210 | 0 | 220 ton | 440 ton | 660 ton | 880 ton | ..... | 0 | 0 | 0 | 0 |
| 10,000 T. Fr. 13 Knots Single Screw 12¼ K. Tw. Scr. | 4600 I.H.P. | R.E. & S.B. | 910 ton | 363,000 | 57 ton, $570 | 114,000 | 3,300 | 117,300 | 14,640 | 54,500 | 186,440 | 12 ton | 910 ton | 1,820 ton | 2,730 ton | 3,640 ton | 1,090 ton | 0 | 730 ton | 1,640 ton | 2,550 ton |
| | | R.E. & W.T.B. | 750 ton | 352,000 | 57 ton, $570 | 114,000 | 3,300 | 117,300 | 14,640 | 53,500 | 185,440 | 12 ton | 910 ton | 1,820 ton | 2,730 ton | 3,640 ton | Above Feed Water Requirement | 0 | 730 ton | 1,640 ton | 2,550 ton |
| | 4200 S.H.P. | G.T. & S.B. | 780 ton | 346,000 | 47 ton, $470 | 94,000 | 3,300 | 97,300 | 14,640 | 52,000 | 163,940 | 12 ton | 760 ton | 1,520 ton | 2,280 ton | 3,040 ton | | 0 | 430 ton | 1,190 ton | 1,950 ton |
| | | G.T. & W.T.B. | 620 ton | 336,000 | 47 ton, $470 | 94,000 | 3,300 | 97,300 | 14,640 | 50,500 | 162,440 | 12 ton | 760 ton | 1,520 ton | 2,280 ton | 3,040 ton | | 0 | 430 ton | 1,190 ton | 1,950 ton |
| | 3400 S.H.P. | 4 Cycle Diesel | 900 ton | 524,000 | 15 ton, $173 | 33,600 | 495 | 34,095 | 16,140 | 78,600 | 128,835 | 0 | 256 ton | 512 ton | 768 ton | 1,024 ton | ..... | 0 | 0 | 0 | 0 |
| | | 2 Cycle Diesel | 800 ton | 547,000 | 15 ton, $173 | 33,600 | 495 | 34,095 | 16,140 | 82,200 | 132,435 | 0 | 256 ton | 512 ton | 768 ton | 1,024 ton | ..... | 0 | 0 | 0 | 0 |
| | | | | | | 300 Days at Sea | | | | | | | | | | | | | | | |
| 10,000 Ton Tanker 11 Knots Single Screw | 2750 I.H.P. | R.E. & S.B. | 587 ton | 237,000 | 34 ton, $340 | 102,000 | 650 | 102,650 | 14,280 | 35,500 | 152,430 | 8 ton | 650 ton | 1,300 ton | 1,950 ton | 2,600 ton | All Taken Up by Reserve Feed Water | 650 ton | 1,300 ton | 1,950 ton | 2,600 ton |
| | | R.E. & W.T.B. | 500 ton | 228,000 | 34 ton, $340 | 102,000 | 650 | 102,650 | 14,280 | 34,200 | 151,130 | 8 ton | 650 ton | 1,300 ton | 1,950 ton | 2,600 ton | | 650 ton | 1,300 ton | 1,950 ton | 2,600 ton |
| | | G.T. & S.B. | 532 ton | 253,000 | 34 ton, $340 | 102,000 | 650 | 102,650 | 14,280 | 38,000 | 154,930 | 8 ton | 650 ton | 1,300 ton | 1,950 ton | 2,600 ton | | 650 ton | 1,300 ton | 1,950 ton | 2,600 ton |
| | 2500 S.H.P. | G.T. & W.T.B. | 445 ton | 246,000 | 34 ton, $340 | 102,000 | 650 | 102,650 | 14,280 | 37,000 | 158,933 | 8 ton | 650 ton | 1,300 ton | 1,950 ton | 2,600 ton | | 650 ton | 1,300 ton | 1,950 ton | 2,600 ton |
| | | 4 Cycle Diesel | 653 ton | 330,000 | 11 ton, $130 | 39,000 | 195 | 39,195 | 12,720 | 49,500 | 101,415 | 0 | 210 ton | 420 ton | 630 ton | 840 ton | Could be used as cargo space | 210 ton | 420 ton | 630 ton | 840 ton |
| | | 2 Cycle Diesel | 545 ton | 352,000 | 11 ton, $130 | 39,000 | 195 | 39,195 | 12,720 | 52,600 | 104,515 | 0 | 210 ton | 420 ton | 630 ton | 840 ton | | 210 ton | 420 ton | 630 ton | 840 ton |
| | | | | | | 200 Days at Sea | | | | | | | | | | | | | | | |
| 17,000 Ton Passenger 15 Knots Twin Screw | 8000 I.H.P. | R.E. & S.B. | 1700 ton | 720,000 | 94 ton, $940 | 188,000 | 3,300 | 191,300 | 32,940 | 108,000 | 332,290 | 16 ton | 1,300 ton | 2,600 ton | 3,900 ton | 5,200 ton | 1,200 ton | 100 ton | 1,400 ton | 2,700 ton | 4,000 ton |
| | | R.E. & W.T.B. | 1400 ton | 700,000 | 94 ton, $940 | 188,000 | 3,300 | 191,300 | 32,940 | 105,000 | 329,240 | 16 ton | 1,300 ton | 2,600 ton | 3,900 ton | 5,200 ton | Above Feed Water Requirement | 100 ton | 1,400 ton | 2,700 ton | 4,000 ton |
| | | G.T. & S.B. | 1440 ton | 580,000 | 77 ton, $770 | 154,000 | 3,300 | 157,300 | 32,940 | 87,000 | 277,240 | 16 ton | 1,075 ton | 2,150 ton | 3,225 ton | 4,300 ton | | 0 | 950 ton | 2,025 ton | 3,100 ton |
| | 7200 S.H.P. | G.T. & W.T.B. | 1140 ton | 560,000 | 77 ton, $770 | 154,000 | 3,300 | 157,300 | 32,940 | 84,000 | 274,240 | 16 ton | 1,075 ton | 2,150 ton | 3,225 ton | 4,300 ton | | 0 | 950 ton | 2,025 ton | 3,100 ton |
| | | 4 Cycle Diesel | 1840 ton | 800,000 | 31 ton, $360 | 72,000 | 495 | 72,495 | 27,000 | 120,000 | 219,495 | 0 | 435 ton | 870 ton | 1,305 ton | 1,740 ton | ..... | 0 | 0 | 105 ton | 540 ton |
| | | 2 Cycle Diesel | 1510 ton | 855,000 | 31 ton, $360 | 72,000 | 495 | 72,495 | 27,000 | 128,000 | 228,495 | 0 | 435 ton | 870 ton | 1,305 ton | 1,740 ton | ..... | 0 | 0 | 105 ton | 540 ton |

R—Reciprocating Engine. G.T.—Geared Turbines. S.B.—Scotch Boilers. W.T.B.—Water Tube Boilers.

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The machinery weights do not include hull engineering or any portion of the machinery usually located in the engine room but necessary for deck machinery only, such as auxiliary generating sets for generating electricity to be used on electric deck machinery. I have not given the cubic required for the machinery space, because in all cases the space required is so near the 13 per cent required by the U. S. Tonnage Rules as not to justify the loss of the 33 per cent deduction to gross tonnage, which is permitted when machinery space is at least 13 per cent of the cubic of the ship.

I have not dealt with the engines which offer the greatest saving in space and weight, because up to the present time none have been built in this country, but it would appear to me that the opposed-piston type oil-engines, like the Fullagar and the Doxford, offer many advantages that cannot be overlooked by the prospective shipowner. From reports available, the YNGAREN, fitted with a 3,000-horsepower opposed-piston-type engine, made by the Doxford Company, has given an excellent account of herself for her maiden voyage from the British Isles to Australia and back. This engine offers one or two very desirable features, viz., a slow-running engine for comparatively large powers, with the consequent efficient propeller, considerably smaller engine-room space and one shaft alley only.

Owing to the Diesel-engine builders standardizing around an engine of 2,500 shaft horsepower, I have used this power upon ships of 7,500 to 8,800 tons and on a 10,500-ton tanker. This assumption makes machinery for these types cost and weigh about the same, but gives us slightly different speeds. (The above figures hold good only so far as new machinery is concerned.)

It so happens, however, that at the present time there is hanging over the market a very large tonnage owned by the Emergency Fleet Corporation and available at very much lower prices than the present actual costs for replacing the same. To convert any one of these 7,500 to 12,000-ton steamers into Diesel engine-driven boats, with 2,500 shaft horsepower Diesel engines, maintaining the existing auxiliary steam-driven machinery and deck machinery, would cost approximately $400,000, and this same change, together with changing the auxiliaries and deck machinery to the electric drive, would cost in the neighborhood of $550,000.

The first proposal would save the shipowner approximately 18 tons of oil a day; the second would save him about 22 tons of oil a day. For 200 days a year at sea and 165 days in port, at $10 a ton for oil, the total saving for steam auxiliaries and Diesel propelling engines in oil would be about $36,000, and the extra for fixed charges would be $60,000. For Diesel propelling engines and electric deck machinery the initial cost would be in the neighborhood of $550,000. Saving in fuel-oil would be 22 tons for 200 days and 5 tons for 165 days at $10 a ton—$53,000—and the extra due to fixed charges would be $83,000. The extra cost of lubricating-oil for the Diesel engine will be offset by the decrease in cost of operating personnel, so that, assuming the same price, whether the owner will run the ship as a motorship or as a steamship, the conversion is not justifiable except for the long voyages; but if these ships can be bought for conversion purposes at $30 a ton less than would be paid to continue as steamships, the fixed charges are reduced on a 10,000-ton ship to $37,000, and for almost any trade this change would be justifiable.

For conversion purposes under the Shipping Board plan, where new Diesel machinery *must* be had, it would appear that the larger boats offer the best possibilities.

Before closing I should like to say that, while I have taken 200 days at sea and 165 days in port per year for all the types except the tanker, this figure must, of course, depend on the trade the vessel is employed in. There are some trades where a ship is in port almost half the time, and it must be remembered that while a ship is in port it is not earning anything while the fixed charges are still going on. Therefore the more costly propelling machinery is at a disadvantage as compared to a cheaper type running only a small portion of the time.

While I consider the table (Plate 1) a good guide, the only way the best type can be selected is by a careful comparison of the different types in the particular trade an owner wishes to engage in along the lines given in the table, taking into account the character of the freight, length of voyage, freight rates, cost of fuel-oil at ports of call, etc.

## DISCUSSION

J. C. SHAW (of Wm. Cramp & Sons Ship and Engine Builders): Mr. Chairman and members of the Society: Mr. Ackerson is to be commended on his interesting paper although it is open to controversy. It is regretted that he has failed to give us more basic data from which he draws his general conclusions. It would have been more illuminating, for instance, had he given more particulars in regard to the hulls for the size of ships he has under consideration. It would also have been of particular interest had he carried out his figures for the net earning-capacity, both on dead-weight and bulk cargo carried for the particular lengths of routes chosen. He refers to the unfavorable higher revolutions of the motorship compared with the steamer as affecting propeller efficiency which he states is in the ratio of 110 to 75. This proportion of revolutions, however, only holds good for a twin-screw motorship and a single-screw steamer, not for a single-screw motorship and steamer as is to be implied.

It should be pointed out in this connection that Burmeister and Wain eight years ago ran trials on a twin-screw motorship and a single-screw steamer for determining this point now raised by Mr. Ackerson. This was the motorship SUECIA, having a length between perpendiculars of 362 feet, a beam of 51 feet, 3 in., and a draft of 23 feet 1½ in., corresponding to a displacement of 9625 tons. The steamer was the PRINSSESSAN INGEBORG with a length of 360 feet, a beam of 48 feet, 9 inches, and a draft of 21 feet, 10 inches, corresponding to 8660 tons displacement. The engines in the SUECIA were of the earlier design of Diesel engines in which the high-pressure stage of the injection-air compressor only was connected to the main engine, thus giving a mechanical-efficiency of 80 per cent against the steam-engine of approximately 90 per cent. At 11 knots and taken from the standardization curves, the Diesel I.H.P. is 2,130 and the steam 2,050. Correcting the power of the motorship to that of the steamer, in proportion to the 2/3 power of the displacements, the Diesel I.H.P. of the twin-screw vessel actually becomes less by 50 H.P. than that of the steamer, though the former is handicapped by the lower mechanical efficiency.

Burmeister and Wain have recently developed a line of special long-stroke four-cycle single-acting Diesel engines for single-screw vessels of the smaller type and which engines are designed to run at the same revolution as the single-screw steamers. It might be mentioned, also, that the Cramp Company are building one of these engines for installing in the Hog Island A-ship SEEKONK, in which the speed of revolutions will be kept the same as for the original steamer.

Mr. Ackerson also particularly refers to the single-screw motorship YNGAREN, having an engine of the opposed-piston type, for bearing out his original statement. With two cylinders added to the SEEKONK'S the I.H.P. becomes 3,000, or the same as that of the YNGAREN, with the weights of the engines practically identical. From published data, I found that the single-screw vessel above referred to requires from five to ten per cent more indicated horsepower than a Burmeister and Wain twin-screw installation, and actually consumes 15 per cent more fuel based on the indicated horsepower as developed.

Mr. Ackerson refers to the advantage of the one shaft alley versus the two shaft alley, but this only holds good for the smaller size vessels. In the larger vessels the increased cargo-capacity, by having only one alley, is proportionately smaller and more than outweighed by other advantages peculiar to the twin screws, as, for instance, the greater propulsive efficiency, better manouvering qualities and less length of the engine-room required. It has been found that the differences in the propulsive efficiencies of the single-screw and the twin-screw ships is more favorable for the latter with the increasing size of vessel.

Criticism is to be made of the powering of the vessels as shown on Plate 1. This is particularly so of the 7,800 tons, 8,800 ton and 10,000 ton dead-weight vessels which have the same power of 2,500 S.H.P. and designed for 11, 10½ and 11 knots respectively. For the smaller vessel, which is apparently the Hog Island type A vessel, 100 more shaft horsepower is to be employed than for a standard type of motorship of 9,500 tons D.W. built in large numbers abroad with a sea speed of 11 to 11¼ knots. For the 8,800 ton, Mr. Ackerson apparently has in mind the type built at his yard which at 11 knots requires approximately 20 per cent more effective horsepower over some other vessels of the same deadweight but of about 10 feet more length between perpendiculars.

It should be mentioned here that in drawing comparisons between the steamers and motorships this is too frequently done by using steam machinery of very light and cheap construction which barely pass the inspection rules. These vessels accordingly only operate at about 70 per cent of the rated capacity in actual service. The motorship machinery, on the other hand, must be made of the highest class of workmanship and material and will always deliver its rated power, being in no way influenced by conditions outside of the control of the engineer personnel.

It would have been more instructive, showing a much more favorable condition for the motorship, had Mr. Ackerson made his comparisons on the basis of equal net cargo-carrying capacities for the particular types of machinery. As a rule, it would have been found, taking into consideration the smaller all around year horsepower required for the motorship, due to the better immersion of screws under all conditions of draft and more uniform running conditions, that the motorship would be appreciably smaller than the equivalent steamer resulting in a smaller investment of capital, and a higher earning rate on same.

W. W. SMITH (of Federal Shipbuilding Co.): On page 2, the author states that weight is the least important of the economic factors. From my study of the subject, I conclude that weight is, next to fuel consumption, the most important factor. Since the cost per pound for this class of machinery does not vary greatly, the first cost is largely a function of the weight. And, in addition, the dead-weight and the cargo-earning capacity is reduced in proportion to the weight for dead-weight vessels.

With reference to loading, the class of cargo determines whether it is a cubic or dead-weight vessel. Certainly there are many vessels which are loaded to the draft marks, including tankers, colliers, ore carriers, general cargo vessels handling weighty cargo, etc. It would seem therefore, that the author's statement in this respect is not entirely correct.

Referring to the propulsive efficiency on page 2, the twin-screw vessel will probably be slightly more efficient; but the difference will probably be not more than three or four per cent. Referring to the problems in Mr. Stevens' paper where the speed is about 11.5 knots, we have for single-screw vessels propulsive efficiencies based on S.H.P. as follows: (1) 0.62; (3) 0.645; (4) 0.595. The only twin-screw vessel of this speed is problem (13) where the efficiency is 0.54, which, however, is probably low. These values do not show that single-screw vessels are particularly inefficient.

In comparing the propulsive efficiencies of single and twin-screw vessels, it should be remembered that, while the single-screw losses are considerably due to a high effective slip ratio, it on the other hand, gains greatly due to the higher hull efficiency.

With reference to revolutions, increasing the revolutions for given conditions of speed and power will reduce the propulsive efficiency. This effect is well illustrated by the P-d diagrams in Admiral Taylor's book. Thus the tendency to high revolutions for Diesel engines results in reducing the propulsive efficiency.

Referring to the advantages pointed out on page 3 for double-acting engines, we have made a number of comparisons which agree with this. In addition to the larger powers possible, these engines are much lighter, and should therefore cost less. Referring to plate 1, the data given are too general in character; and, there are not sufficient particulars to make a really accurate comparison; a description of the machinery installations is desirable. The types and makes of engines, turbines, gears, etc., will have an important bearing.

In addition to the general type of machinery, the design and conditions are important. There may be wide variations in weight, cost and efficiency due to these causes. For example, the fuel-oil consumption of a geared turbine vessel may vary from 0.85 lb. to 1.3 lb., depending on these factors of which we are not informed. The weight and cost may vary likewise. The revolutions will influence the weight and efficiency considerably.

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In making a comparison of this kind, the best designs and conditions should be selected. Apparently this has not been done for the 2,500 S.H.P. geared turbines. At any rate, the results given are inferior to those which we have obtained with certain designs of Parsons' turbines.

Referring to the column headed weight, it would be interesting to know whether this is the weight wet or dry, and whether any feed-water has been included. The weight of the geared-turbine machinery with Scotch boilers for the 2,500 S.H.P. installation is given as 570 tons, or 510 lbs. per S.H.P. which is assumed to be the wet weight. This seems too high since we have built a number of 2,600 S.H.P. installations which weighed 480 tons or 413 lbs. per S.H.P. We have also built a number of 3,100 S.H.P. installations which weighed 560 tons or 404 lbs. per S.H.P.

The weight of the 7,200 S.H.P. installation of geared-turbines and water tube boilers is given as 1,140 tons or 354 lbs. per S.H.P. If I am informed correctly, the weight of the machinery installation on the "President Pierce" is 1,040 tons or 180 lbs. per S.H.P. using the trial power. This is considerably less than given in the table.

The fuel-consumption of the 2,500 S.H.P. geared turbine vessel is given as 34 tons per day or 1.27 lbs. per S.H.P. This is surely a very poor performance. In view of this, it would be of value to have particulars of the turbine design, steam conditions, etc. For Parsons' turbines, of good design, we would estimate a fuel-consumption of 1.08 lbs. per S.H.P., or 29 tons per day. The steam conditions are—200 lbs. 50 deg. sup. and 28¼ in vacuum. For the 7,200 S.H.P. installation the table gives a very much lower fuel-consumption than above or 1.0 lbs. per S.H.P. for a 3,600 S.H.P. unit. Values so far apart do not seem very consistent.

The fuel consumption of the two-cycle installations are exactly the same as for the four-cycle. It is my understanding that for usual designs, the two-cycle will use about 7 per cent more fuel than the four-cycle. It is noted in group No. 4 that 3,400 S.H.P. twin-screw Diesel vessels are compared with 4,200 S.H.P. single-screw steam vessels. With such a wide difference of power I cannot see how such a comparison can be of practical value.

The price of fuel-oil for the steam vessels is taken at $10.00 per ton, whereas the Diesel oil price is $11.50, $11.60 and $11.80. The price differential is therefore 15 to 18 per cent greater for the Diesel oil, which is rather low.

Referring to the length of voyage between fueling ports, the table gives distances up to 20,000 miles. For most of the trade routes used by American vessels, a leg of over 6,000 miles is not ordinary. Hydrographic Chart No. 1262 illustrates this very clearly.

Referring to the saving of 22 tons per day given on pages 4, this would apply to an inefficient steam installation; but for an efficient Parsons' turbine, I would expect a difference of about 17¾ tons. For the 2,500 S.H.P. installations, the fuel-consumption of the steam-engine and turbine are both given as 34 tons. For the 7,200 S.H.P. installation the steam-engine consumption is given as 94 tons, whereas the turbine is given as 77 tons. This appears inconsistent.

The differential of $30.00 per D.W.T. referred to on page 4, would amount to $300,000 for a 10,000-ton vessel. *No doubt, with such a differential, it will prove profitable to install Diesel engines in these hulls.*

Referring to the last paragraph and to Plate 1, this data may be of value in considering the particular designs upon which this table was based; but I think it would be misleading in several respects to use it generally. Some of the data do not represent the best practice. Also, the conclusions which may be drawn from such a table may be in error. Furthermore, a comparison of the engine room machinery only neglects certain factors which have an important bearing. Consequently, to obtain a true comparison, it is necessary to compare values for the complete vessel. I agree with the author that the only safe way to determine the best type of machinery is to prepare an estimate of net earnings for the particular designs and routes concerned. The truth is that, at present, the economic advantage of the Diesel engine over the best type of turbine installation in most cases is not great; and, rather close figuring is required to decide the best type. In such a close comparison, a change in economic conditions may reverse the decision.

There are many cases where the best designs of Diesel machinery have advantages. Furthermore, the field of the oil-engine is increasing. However, its commercial value would be greatly increased by reducing the weight and first cost.

JOHN L. BOGERT (Consulting Engineer): After what has been said in this discussion and thanking Mr. Ackerson for bringing up the subject, I will not take up much of your time. I will show you some things by Mr. Ackerson's own figures, if you turn to his Plate 1—you will see that he states there that the steamer of 7,800 tons deadweight capacity consumes for 24 hours 34 tons of oil, and that the Diesel ship is put down as using 11 tons.

This morning we heard interestingly from Mr. Mallory, ship owner and operator, that he could not run a ship on oil down to South Africa because he could not get oil down there, and he had to buy coal at Durban and very poor coal, at that. Mr. Ackerson has not given the Diesel engine due credit for what it can do on short runs. In a run to Norway the captain of a Scandinavian boat, that had an engine of about this size, reported that he sold enough oil out of his double-bottom in Norway to pay every last darn cent of cost of fuel for his ship. That means something. There is $83,000 put down here, every last cent of which belongs to the credit of the motorship on that run, and the same way in the case of Mr. Mallory.

We may talk about the Hog Island ship. I will not go into anything bigger, because they are a drug on our hands—we have so many of them; and some of the speakers, on standardization, put a quietus on ships of this size for many years to come. Many of these ships will be changed to Diesel engine ships, and I will not discuss whether they will be a long-stroke engine—Diesel engine at 80 R.P.M., or whether someone will make them twin-screw. The other answer would be an electric motor on the shaft and Diesel engines in the engine-room developing the juice.

There are two or three good solutions for these methods, but the point I want to bring out is this—that on their way to Scandinavia and back it is perfectly possible for a ship that can load a thousand tons of oil in her double-bottom to actually travel for nothing, so far as fuel goes. I will give your Secretary the figures, and he will perhaps publish them, and you can take the trouble to hunt them up, because if you will take $15.00, you will see what it means—at $15.00 a ton, on the basis of 34 tons per day, with 30 days for a round trip, it would amount to 1,020 tons.

You only have 1,000 tons capacity in the bottom of the boats, to take care also of surplus fresh-water for your water-tube boilers, and you must have 15 per cent. standby, in case of emergencies which means it would be 1,174 tons for a 30-day round trip per steamer.

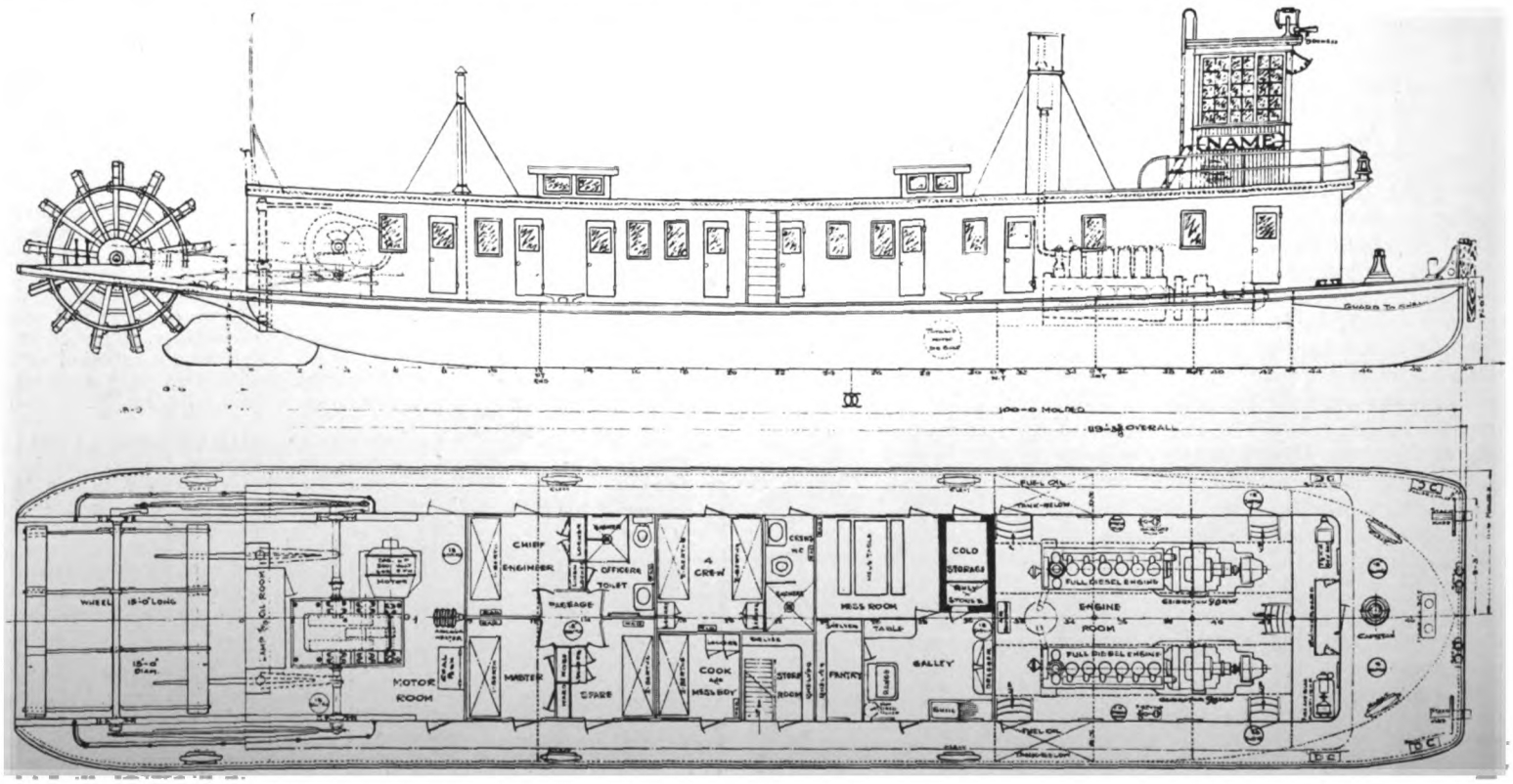
Let us take Mr. Ackerson's own figures, 11 tons for the Diesel engine ship—and I want to tell you that the "Selandia" and the "Jutlandia" have not burned over nine tons per day. I am giving you the benefit of the doubt, and charging the motorship up with eleven tons. Eleven tons per day for 30 days means 330 tons, and adding 15 per cent., which is 49.50, amounts to 379.50 tons. If you subtract 379.50 tons from 1,174, you will get 744.50 tons, in the double bottom, which could be saved out of that ship to pay her expenses. Thus, taking the figure of $10.00 a ton for oil, means you will have approximately $5,000 on that transportation. In that case, $3,972.50 for what you sold, and the cost at $10.00 a ton for what you burn—you will remember that the cost of $3,795.00—you would be ahead almost $200, besides paying for all the oil you burn on the round trip, there and back.

I do not quite reconcile the figures which appear under the ten-thousand ton tanker, with 2,500 shaft horsepower, that being a tanker having lighter machinery than the 7,800-ton tanker, with the same shaft horsepower, namely, the tanker machinery, weighs more due to the additional pipes and pumps. There may be some slight error there.

CHAIRMAN SADLER: If there are no further remarks in this discussion, the remarks which have been made will be submitted to Mr. Ackerson, and he will be given an opportunity to reply.

## OIL-ENGINES IN COAST GUARD SERVICE

On her way from Newport News, Va., to her new station at Ketchikan, Alaska, the U. S. Coast Guard cutter "Smith" towed two 110 ft. submarine chasers as far as Panama, often through heavy seas. Her two 60 h.p. Fairbanks-Morse oil-engines propel her at 9½ knots.




**General arrangement plans of the Diesel-electric stern-wheel tow-boat recently ordered from the Charles Ward Engineering Works by the U. S. Engineers Office. The propelling machinery consists of Winton Diesel-engines coupled to Westinghouse generators**

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# Launch Fleet to be Converted

## *Eight Pacific-Werkspoor Diesel Engines Ordered by Crowley Co. of San Francisco*

EFFECT on the amount of ocean-freight tonnage that the installation of Diesel-engines in launches and tugs may have through lowering the cost of handling freight in harbors and in river and canal shipments is significantly illustrated in the decision of the Crowley Launch & Tugboat Company of San Francisco to convert eight of its twenty-six launches to Diesel power. The decision was announced October 26, and their contract with the Pacific Diesel Engine Company of Oakland for installing 125 brake horse-power Pacific-Werkspoor Diesel engines in these boats calls for delivery within sixty days.

If the success of the new equipment comes up to expectations, the Crowley company intends to convert all of its launches to Diesel power. According to David Crowley, the company expects its operating costs for these boats to be cut down two-thirds, a reduction which he says will make it possible to haul a great deal of freight around San Francisco bay and up the Sacramento and San Joaquin rivers more economically than ever before, thus increasing the amount of water-borne commodities delivered to points removed some distance from the spot where ocean freight ships unload.

The Crowley launches do a large amount of hauling freight from the docks in San Francisco and Oakland to other points on the bay and up the river, and some of the barges on which the freight is towed carry as much as 1,000 tons. Their launches at present burn twelve or thirteen gallons of distillate an hour, at a cost of 15½ cents a gallon, while with Diesel engines they expect an hourly fuel-consumption of five gallons at four cents a gallon. Thus the fuel charge should be reduced from $1.86 an hour to 20 cents.

The relation that the ocean freight bears to the local cost may be illustrated by the charges on vegetable oil, although, to be sure, the damage that this oil does to lighters and barges necessitates a higher handling charge than on some other commodities. One shipment of linseed oil from London to San Francisco last summer cost about $1.54 a barrel, while another from the Orient to San Francisco cost in the neighborhood of $1.80; for lightering at San Francisco the charge was 15 cents a barrel, with 15 cents more for removing from the lighter to the State vegetable oil terminal near San Francisco. The State Harbor Commission, which controls the San Francisco water front, has been attempting to promote the use of a water terminal at the southern end of San Francisco bay as a receiving point for fruit shipments from the fertile Santa Clara valley. With Diesel-engined work-boats to haul canned and dried fruit from such a terminal to ocean craft at San Francisco it is likely the cost of exporting these commodities could be materially reduced.

The installation of the eight three-cylinder Pacific-Werkspoor engines in these launches will be done at the Crowley yards in East Oakland. The launches are 64 feet long and draw 7 feet of water. Some are 20 feet in beam, others 18 feet.

### MOTOR VESSELS FOR STANDARD TRANSPORTATION COMPANY

By the time our December issue closes for press an order probably will have been placed for two twin-screw Diesel-driven tank barges, by the Standard Transportation Company of New York. Bids for the same were received up to November 4. The vessels are to be used in New York harbor and State Canal service, the owners being a subsidiary to the Standard Oil Co. of New York. They have the following dimensions:

| | |
|---|---|
| Deadweight capacity | 1,800 tons |
| Length | 254′ o.a. |
| Breadth | 37′6″ |
| Depth (moulded) | 14′ |
| Power | 600 shaft h.p. |
| Draft | 12′0″ |

Oil will be carried in bulk in holds provided by nine oil-tight bulkheads. The propelling plant in each boat will consist of two McIntosh & Seymour Diesel engines of the 6-cylinder, 4-cycle type developing 300 shaft h.p. each.

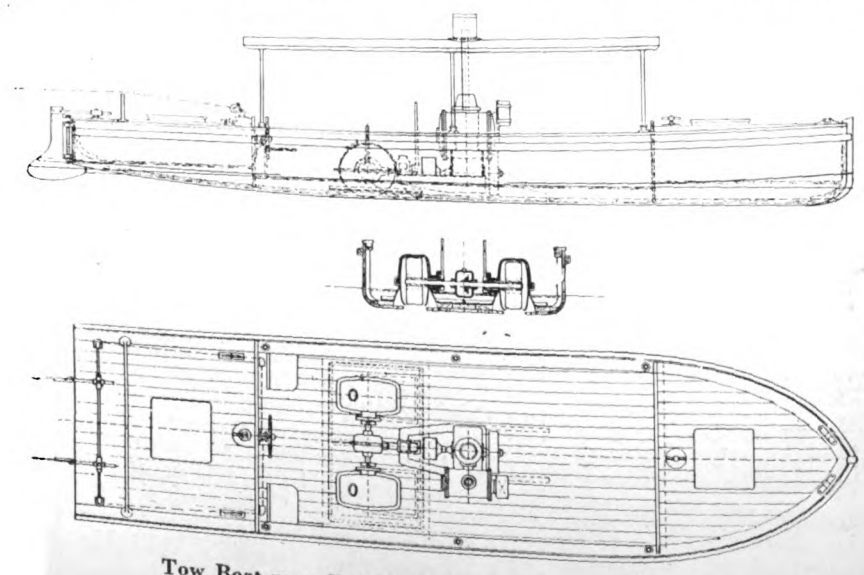
# Hydraulic-Propulsion for Shallow-Draft Vessels

## *The Hotchkiss System Has Proven Efficient in Actual Service*

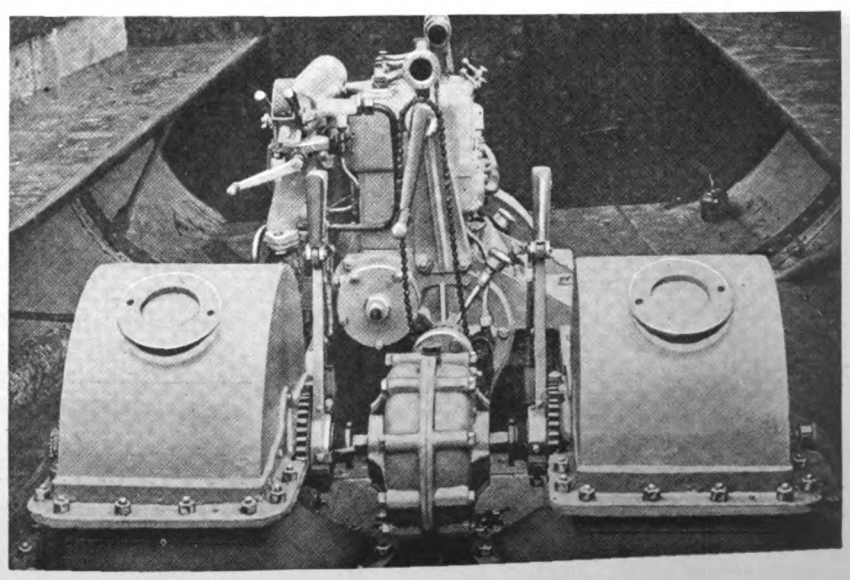
MANY types of mechanical propulsion for craft operating in shoal waters have been evolved, but none more interesting than that depicted on this page. This is one designed and installed by the Hotchkiss Hydraulic Propeller Company, Ltd., of London and boats which have been equipped with this power plant have demonstrated its efficiency. By referring to the illustrations it will be noted that no screw propeller or paddle-wheel is provided and that the entire unit is installed preferably amidships. There are no propeller shafts, struts, etc., the engine and propelling-apapratus being mounted on a base entirely above the bottom of the boat, nothing projecting below it.

An internal-combustion engine drives a pair of hydraulic-propellers through bevel-gear which reduces the revolutions of the engine to the most suitable speed for the propellers, alteration of the gear-ratio being equivalent to change of pitch in a screw propeller. Within the two welded steel drums shown are inner-drums within which impellers are rotated by means of the driving-shaft. This rotation has the effect of forming a vortex in each drum, each vortex discharging tangentially and being fed in the direction of its rotation by two converging streams of fluid, which meet at a point between the centre and the circumference, where the rotational speed is approximately equal to the velocity of feed. The action of the propeller is to accelerate the water drawn in at the sides of the vortex to the velocity of discharge, which is greater than that of the forward velocity of the ship, but in the opposite direction, so as to obtain a reaction which constitutes a thrust.

Reversal takes place when the inner-drum is rotated so that the peripheral cutting forming the discharge opening is brought into register with the reversing-port, thus projecting the water in the forward direction and causing the boat to go astern. Manoeuvring is accomplished by simply moving the levers, each of which operates one of the two propellers independently of the other. The engine is under constant load at all times and when it is desired to relieve the engine of all propelling-load it is only necessary to move the lever to the horizontal position, which brings the inner-drum into such a position that the cuttings are masked by the surfaces of the outer drum and there is no pumping load, the water simply rotating. Extremely delicate control and manoeuvring ability is claimed for this type of propulsion, which seems fitted to a variety of craft. Grids over the openings of the intakes prevent debris entering same and there are no pipes or small clearances into which this could enter. The Hotchkiss system by reason of its normal weight and bulk as compared with early hydraulic-propulsion installations seems to fill a real need for shoal-draft boats.



Tow Boat propelled by the Hotchkiss System



The complete unit requires little space

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# Interesting Notes and News from Everywhere

A. M. LOVELL, of Port Blakely, Wash., is installing a 16 h.p. Frisco-Standard engine in a fishing boat.

A 300 h.p. Fairbanks Morse oil-engine is being installed in a new towboat being built for the Arundel Corp. of Baltimore, Md.

In a bill now before the Italian Parliament a sum of 22,000,000 lire is provided as a subsidy for the construction of cargo motorships.

On December 5, A. J. Brown is reading a paper before the Institute of Marine Engineers, Inc., London, entitled "Marine Diesel Engines."

Twenty-two Diesel motorships aggregating 110,000 gross tons form the fleet of the East Asiatic Company of Denmark, all built since 1912.

The annual meeting of the American Society of Mechanical Engineers will be held at the Engineering Society's Building in New York, December 4 to 7.

It is believed that the motor-schooner IRMA, of Kungsviken, Bohusland, has been blown up by a mine in the Baltic Sea, en route from Slite to Stockholm, with a cargo of concrete.

Mr. Olson, of Minot, Olsen & Thurber, Boston, Mass., United States representatives for the Bergunds oil-engine, sailed recently for Sweden to visit the Bergunds factory.

The General Engineering Co. of San Francisco, George Armes, president, has purchased the Barnes & Tibbitts Shipbuilding and Dry Dock Co. at Alameda, Cal.

JEANNETTE SCOTT is the name of the 120-foot oil-engined passenger boat now building for the Adams Boat Line, Inc., illustrated on page 851 of our November issue.

Diesel engines are being constructed by the Cantiere Navale San Marco, a subsidiary of the well-known Italian firm of Stabiliments Tecnic Triestino.

Vickers Limited of Barrow, England, have secured an order for a twin-screw set of airless-injection oil-engines for a Japanese coastwise vessel.

Capt. N. L. Johnson, of Seattle, has increased the power in his towboat, LA SIRENA, by installing a 100 h.p. Fairbanks Morse oil-engine, replacing a 45 h.p. engine of the same make.

The Enterprise Diesel-engined schooner, SEQUOIA, returned to San Francisco in October from her first voyage to the lumber ports of Washington, loaded with 350,000 feet of lumber.

The East Asiatic Company of Copenhagen, Denmark, has opened a branch office in Seattle with M. Bildsoe in charge. This company maintains a schedule of monthly sailings in its Seattle-European service.

Trial trips of Wilhelm Wilhelmsen's new motorship TIRADENTES were recently run from the Deutsche Werft, Hamburg. She is due to arrive in New York as we close for press.

A considerable amount of constructional work has been done on the Vickers airless-injection oil-engines for the British navy mine-layer now building in one of the Admiralty's dockyards.

Built for foreign service a 135-tons coastwise motorship has been launched at Alley & Maclellan's yard, Glasgow, Scotland. A 120 b.h.p. Beardmore surface-ignition oil-engine is fitted.

Sale of the Diesel-propelled wooden motor tankship J. F. PENROSE, 2,307 tons net, formerly owned by the National Oil Transport Co., has been ordered by the referee in bankruptcy at the U. S. District Court of Texas.

MARIA, **ex** PUSEY JONES II, an Avance oil-engined auxiliary vessel built on the Delaware during the war, is now owned by Fratelli Campisi of Syracuse. For auxiliary purposes she has a 9 h.p. Mietz engine.

Arrangements to build Sulzer Diesel-engines under license for auxiliary purposes have been made by G. & J. Weir & Co., Ltd., Cathcart, Glasgow, Scotland, with Sulzer Freres of Winterthur, Switzerland.

A 450-ton barge carrying 15,000 bushels, or ten railroad car loads, would receive $2,100 in freight for a single eastbound trip on the New York State Canal, says Frank S. Gardner, secretary, New York Board of Trade and Transportation.

**THE ART-ADVERTISING SUPPLEMENT**

Owing to a continuation of the series of tests on the new American marine oil-engine that is to form the center of interest of the forthcoming Art-Advertising Supplement to MOTORSHIP, its publication will be delayed until our January or February issue, which will allow full test reports to be included.

An 800 tons motor-tanker has just been launched at the yard of the Societe des Chantiers Navales et Chaudronneries du Midi at Marseilles, to the order of the Societe Gen. des Hules de Petrole. A 200 b.h.p. oil-engine is installed.

PROSPECT PARK, a new towboat owned by the recently organized Prospect Shipping and Towing Co. of Victoria, B. C., has been equipped with a 70 to 90 h.p. Kahlenberg oil-engine. She is 60 feet long, 13 feet breadth and has a fuel capacity of 1,000 gallons.

For the purpose of generating electricity for economical cooking and heating, one of our steamship-owner readers, namely, A. T. Hatch, of the Monticello Steamship Co. of San Francisco, has installed a Worthington oil-engine in one of his passenger steamers.

Two oil-engine papers are shortly to be read before the Graduate Section of the North East Coast Institution of Engineers and Shipbuilders, namely: (1) The Balancing of Oil Engines; (2) Development of the Internal-combustion Engine.

Tadge D. Madsen, Superintendent-Engineer of the Transatlantic Steamship Co. of Göteborg, Sweden, is reading a paper entitled "Internal Combustion and Economy" before the Institute of Marine Engineers, Inc., London, on February 27, 1923.

For the purpose of purchasing Diesel-engines for two 6,600-tons cargo motorships building in Japan and possibly a constructional license for Mitsui & Co., Mr. Y. Okamoto of that company sailed from New York for Europe at the end of October.

A small motor vessel named BUKURYA has been launched by the Cantiere Navale Felice Doria at Trieste for Halil Aga of Scutari, Albania. She is of 100 tons capacity and is fitted with a Klimax surface-ignition oil-engine built at the Satima Works, Trieste.

A 100 h.p. Fairbanks-Morse oil-engine has been installed in the halibut-schooner HELGELAND, owned by Jacob Bassi and Louis Holm of Seattle Wash., at the Fishing Vessel Owners' Marine Ways at Salmon Bay. This installation replaces a 125 h.p. distillate-engine.

The new dredge-tender WEKIVA, for the U. S. Engineers, Jacksonville, Florida, will be equipped with a 45 h.p. Fairbanks Morse oil-engine. She is being built by the Gibbs Gas Engine Company at their Jacksonville, Florida, shipyard and will be 40 ft. long 9 ft. 9½ in. beam, draft about three feet.

DRECHTDYK is the name of the third of the six 14,000 tons 6,300 i.h.p. cargo motorships for the Holland-American Line and Royal Mail Packet Company. She was launched at the end of October at Harland & Wolff Yard and is a sister vessel to the DINTELDYK, described some time ago in MOTORSHIP.

The Bay and River Dredging Company of San Francisco has put in service its new tug JERSEY, equipped with a 90 horse-power Atlas Imperial Diesel-engine. The tug is used for towing dredges and barges on the Sacramento and San Joaquin rivers and on San Francisco bay.

L. S. Swinnerton-Dyer read a paper entitled "The Limit of Power of Diesel Engine Cylinders" on November 15 before the North East Coast Institution of Engineers and Shipbuilders, Newcastle-on-Tyne, England. Both four and two-cycle type Diesel engines were dealt with.

Richard Froboese has been appointed by Henry Lund & Co., Pacific Coast representatives of the Bolinder Engine Co., to act as their representative in Seattle, Wash., where Mr. Froboese has made temporary headquarters with Chandler-Hudson Co., 73 Columbia Street.

The motorship MOONLITE, one of four oil-engined motorships purchased by the Admiral Line last spring for conversion to higher power, arrived at San Francisco from the Atlantic Coast in October and will be tied up in the Oakland estuary indefinitely, according to officials of the company.

We have received a subscription to MOTORSHIP from H. L. Klein, 17 Hamilton Avenue, Brooklyn. Copies of the magazine are being returned by the Postoffice Department marked "not found." Will Mr. Klein

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or one of his friends kindly forward his correct address to this office.

Bids on two 12,000 to 13,000 tons deadweight refrigerator-type motorships of 15 knots speed have been invited from British shipbuilders by a New Zealand shipowning company, says FAIRPLAY. They will carry frozen meat, fruit and dairy products, and will have 465,000 cubic feet of insulated cargo space.

The Diesel-electric ferry GOLDEN GATE, which began operations between San Francisco and Sausalito in July with a speed of 12½ knots, is now making a greatly increased speed. Steam ferryboats on San Francisco bay, which at first were eager to try conclusions with the new ship, have refused to run any more races.

Another large motorship has been launched by the Deutsche Werft, Hamburg, to the order of the Hamburg-American Line, namely, the SPREEWALD, of 9,000 tons d.w.c. When completed she will be operated on the run from Hamburg to the west coast of South America. Very shortly a sister ship will be launched at the same yard.

In our last issue we referred to the voyage to Philadelphia of the Doxford single-screw motorship DOMINION MILLER, owned by Furness-Withy. On the return trip from Liverpool via Halifax the average speed was 10.2 knots and a fuel-consumption of 11.2 tons per day. The actual time taken was 10 days 2 hours.

The whaler HERMAN, owned by H. Liebes of San Francisco, has returned from her annual voyage to the Arctic. Her master, Captain Pedersen, reports that had it not been for her Atlas-Imperial Diesel-engine she would undoubtedly have been obliged to winter in the ice, which is not planned in the HERMAN'S voyage.

The great Ansaldo engineering and shipbuilding company in Italy has been re-formed by the Banca Nazionale di Credito, which has furnished the capital of 200,000,000 lire. Ansaldos have been the same to Italy as Schneiders to France, the United States Steel Corporation to America, and Krupps to Germany.

"If American shipowners do not adopt modern machinery, such as the Diesel engine, the electric drive and other improvements," said Frank V. Smith of the marine engineering department of the General Electric Company in a recent address before ocean officers at the Marine Show, "they will be left behind regardless of Government aid."

A number of internal-combustion engine manufacturers will contribute papers to be read on January 12 and 16, 1923, before the North East Coast Institution of Engineers and Shipbuilders, Bolbec Hall, Newcastle-on-Tyne. On December 1, 1922, a paper on Heavy Oils for Oil Engines will be read by Harold Moore; and Paul Belyavin will read a paper on Diesel Engine Auxiliaries on February 2.

A new record for freighters from the Pacific coast to Australia was established recently by the Götaverken—B. & W. Diesel-engined motorship BULLAREN, which made the 6,500 miles from San Francisco to Sydney in twenty-two days and ten hours, within a few hours of the time required by passenger boats and eight days under the ordinary voyage of freighters. The BULLAREN covered nearly 300 miles a day.

Contracts for three 400 ft. by 54 ft. combination passenger and refrigerated products carrying motorships have been placed by the Western Australian Syndicate with two Scottish shipyards. Wm. Beardmore & Co., Ltd., of Dalmuir, have gotten two and the Burntisland Shipbuilding Co. of Burntisland have one. Accommodation for 160 first-class passengers will be provided. Diesel engines will propel all three vessels.

Trials of the motorship DURENDA, owned by the British India Steam Navigation Company and built by Robert Duncan & Co., Ltd., Port Glasgow, Scotland, recently took place. She has a deadweight capacity of about 11,000 tons, as well as accommodations for a considerable number of passengers. Her propelling plant consists of twin 2,330 i.h.p. North British Diesel engines. In addition there are two 200 b.h.p. Diesel-electric generating sets for auxiliaries.

The Shipping Board steamer FRANK LYNCH ex-LAKE SUNAPEE, in which Frank Lynch of the Benson Lumber Company of San Diego, California, will install an 825 brake horsepower Pacific-Werkspoor Diesel engine, arrived at San Francisco November 8. Work on the plans for converting her were started immediately upon arrival. Captain W. J. Gray of San Francisco, who has charge of the work for Mr. Lynch, is expecting to purchase a 60 horse-power auxiliary Pacific-Werkspoor Diesel engine for the engine room.

Work of reconditioning Wm. K. Vanderbilt's new motor yacht ARA has been completed and she is now making a voyage to New York via Lisbon and Trinidad. The ARA was originally built as a yacht for a French yachtsman and was converted to a submarine patrol-vessel during the war. She has a displacement of 1,200 tons and is of 897 tons gross. Her propelling machinery consists of twin 825 shaft h.p. Polar two-cycle Diesel engines, giving her a speed of 13 knots. She carries a crew of 40 officers, engineers and men.

LAURA, a small motor-tanker, was recently launched at the Schichau yard, Hamburg, Germany, to the order of the United Oil Co. of Copenhagen, Denmark, and will shortly be followed by the motorship BODIL. They are single-screw vessels of 100 and 250 tons, respectively, and will be propelled by surface-ignition oil-engines. The *Scandinavian Shipping Gazette* says that this method of transportation is another step in the struggle between the great oil companies for supremacy in supplying oil to Denmark.

A 40 ft. oil-engined barge now building at James Pollock Sons & Co.'s yard at Faversham, England, will be propelled by the Hotchkiss Hydraulic jet system. The little vessel is intended for cargo carrying and towing. The machinery will consist of a 30 h.p. Bolinder oil-engine driving a pair of Hotchkiss Hydraulic propellers through spiral bevel gears. Independent maneuvering will be effected by the levers arranged close together near the helmsman. The hull is of the shallow draft type, 40 ft. long, 8 ft. breadth, 2½ ft. moulded depth and 10 in. moulded draft.

"The Shipping Board has a great number of steamers whose hulls are perfect but whose war-built machinery must be replaced, and thus through the provisions of this shipping bill the United States can be given promptly a fleet of economical motorships to enter our general foreign trade. This fact gives us an advantage over our competitors, who also are building motorships, if we act at once," said Commissioner Edward C. Plummer, U. S. Shipping Board, on board the S.S. PRESIDENT HARDING of the United States Lines, in New York Harbor, before the Convention of Industrial Engineers, on October 18, 1922.

The wooden motorship JAMES TIMPSON, propelled by Winton Diesel engines driving propellers through Falk reduction-gears, has recently been making voyages from New Orleans to British Honduras and Guatemala She has been in service since June 6, bringing 2,500 tons of mahogany logs every voyage. The average fuel used on a round voyage costs $430 and there have been no shop repair bills. For three years the engine-room has been in charge of F. C. Christensen. During the entire period the engines have been in steady and continuous operation.

The new cargo-passenger motorship DUMRA, sister to the motorship DWARKA, sailed for Mombasa early in September last. Both vessels are owned by the British India Steam Navigation Co., Ltd., of London, and have a loaded displacement of 4,150 tons and 2,050 tons deadweight. They are propelled by twin 500 shaft h.p. North British four-cycle Diesel engines driving at 165 r.p.m. Speed 11 knots, length 280 ft. o.a., breadth 43 ft. 6 in., depth 24 ft, draft 17 ft. 8 in. Fuel-consumption 5¼ tons per day, including donkey boiler. Cylinder bore 15 in., piston stroke 30 in. Passenger accommodation, 24 first, 24 second and steerage quarters.

For two years the Nelseco-General Electric Diesel-electric trawler MARINER has been in almost constant operation. We are advised that in manoeuvring ability and general efficiency she is superior to other direct Diesel or steam-driven trawlers of the Atlantic Coast. In very heavy seas there is, because of the delicate control of the electric-drive, no racing of the propeller or "bucking" of the vessel. This steady running has often made it possible for her to lead the fleet to market. It is often asked if specially trained and highly paid engineers are not required for such a vessel, but we are advised that such is not the case. There is no difficulty in obtaining men to operate her machinery and her electrician has had but little trouble with the electrical equipment. Because of the constant service which a fishing craft must give there is very little time in port to attend to slight overhauling and repair, so that she is often operated on long sea trips without getting all the attention which she would otherwise receive.

Norris R. Sibley, who has been in charge of the Westinghouse Electric & Manufacturing Company's Marine Department in New York for several years, has resigned to become New York District Manager for the London Steam Turbine Company of Troy, N. Y. Mr. Sibley has served as assistant and chief engineer in several of the lines of the Merchant Marine, including the American Line (I. M. M. Co.), Clyde Line, Mallory Line, Southern Pacific Co. (Morgan Line), Panama Line (Panama R.R.), Luckenback Line, Benvenue Granite Co. and Metropolitan Dredging Co. For a time he covered the marine field for the New York *World*, the New York *Herald*, and the Sun Press Bureau, and assisted in compiling "The Blue Book of Facts," a book on marine engineering. After leaving the U. S. Army Transport Service, in 1918, Mr. Sibley became connected with the Westinghouse Electric & Manufacturing Company. He is an alumnus of the Massachusetts Nautical School, a member of the National Marine League, and various marine engineering associations. Mr. Sibley's office will be in New York City.

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# Testing a 1000 Shaft H. P. Marine Oil Engine

## *Builders of the "Camellaird-Fullagar" Diesel Engine Release Some Most Interesting Information*

## *Part III*

(*Continued from page 773 October issue*)

THE weight of the fuel-oil used per b.h.p. hour in my tests (1 and (2) is approximately the same as that given in the paper read by Mr. James Richardson before the Institution of Naval Architects in April of this year for the Beardmore-Tosi engine of the motorship, PINZON. This engine is of the four-stroke cycle type, with six cylinders, and its normal power is 26% greater than the normal power of the Cammellaird-Fullagar engine.

During the whole of my tests the engine worked as smoothly and as noiselessly as any marine steam-engine, the amount of attention required for its operation was almost negligibly small, the exhaust gases were absolutely invisible during most of the tests, and in no case were they more than barely visible.

The amount of lubricating oil used for the engine pistons was remarkably small, being only 0.164 gallons per hour when the engine was giving 1,115 b.h.p. This is equivalent to 0.147 gallon per hour per 1,000 b.h.p., or to approximately 7,000 b.h.p. hours per gallon.

At the conclusion of my tests a series of manoeuvring trials were made, and the time for reversal from full speed ahead was 2½ secs., firing in the cylinders began 2½ secs. later and the engine was running full speed astern in 8 seconds from the instant that I gave the signal to reverse.

The engine was run for some time at a speed of 16½ revs. per minute, firing taking place regularly in all cylinders during this time. This speed corresponds to a piston speed of 68.7 feet per minute, which is, I believe, lower than has ever been previously achieved in any internal combustion engine.

The design of the engine is simple, direct and free from unreliable mechanism, and both its design and construction are in accordance with the great reputation established by your firm, and I believe there is a great future for this engine.

(sgd.) W. H. WATKINSON.

May 1, 1922.

The item of the research programme which is of special technical interest is, of course, the study of the thermo-dynamic conditions in the engine. The personnel of the Oil Engine Department of Cammell Laird & Co. include a number of first-class men of long experience with many types of oil-engines. Their resourcefulness and initiative is appropriately demonstrated by the most ingenious, yet inexpensive, way of producing tropical conditions on the test bed; a novel method and one to be highly recommended to all oil-engine testing departments.

In asking Professor Watkinson to conduct the extended tests undertaken a further valuable authentic contribution has been made to the records on the technical science of internal combustion engine. Professor Watkinson's report, of which we are able, thanks to the kind intervention of Cammell Laird & Co., to publish an abbreviated version, ranks high in the annals of oil engine literature because it has been possible to obtain data regarding the operation of the engine in a more complete degree than has ever been previously attempted. When it is possible to bring to bear on the subject under discussion that technical skill, that power of observation and such practical comments as one is accustomed to hear from Professor Watkinson, and the more so as these facilities are specifically developed in the sphere of marine engineering, one cannot doubt that great interest which this classical piece of research will evoke amongst engineers and shipbuilders.

It is impossible that the conditions for any

SUMMARY OF DATA RELATING TO TEMPERATURES.

| | Test Number:— | 1 | 4 | 5 | 6 | 7 | 9a |
|---|---|---|---|---|---|---|---|
| | Date:— | March 20, 1922 | | March 21, 1922 | | | March 31 |
| 1. | Barometer "Hg | 29.95 | 29.97 | 29.99 | 30.00 | 30.02 | 29.44 |
| 2. | Hygrometer—Dry Bulb | 46.6 | 45.5 | ..... | 45.5 | 45.6 | 44.7 |
| 3. | Hygrometer—Wet Bulb | 42.5 | 40.5 | ..... | 41.0 | 41.5 | ..... |
| 4. | Humidity of the atmosphere | .72 | .690 | ..... | .699 | .720 | ..... |
| | AIR-COMPRESSOR AIR TEMPERATURES, FAH.° | | | | | | |
| 5. | 1st stage suction | 100.0 | 101.3 | 81.8 | 80.1 | 87.8 | 103.4 |
| 6. | 1st cooler, before | 186.5 | 182.5 | 161.5 | 160.5 | 164.0 | 187.7 |
| 7. | 1st stage cooler, after | 137.0 | 132.5 | 122.0 | 114.0 | 119.0 | 134.8 |
| 8. | 2nd stage cooler, before (1) | 273.9 | 297.5 | 248.4 | 252.9 | 273.2 | 306.1 |
| 9. | 2nd stage cooler, before (2) | 168.1 | 164.8 | 132.0 | 135.0 | 146.0 | 174.4 |
| 10. | 2nd stage cooler, after | 91.0 | 88.0 | 64.5 | 77.0 | 81.0 | 93.6 |
| 11. | 3rd stage cooler, before | 273.2 | 282.2 | 191.3 | 217.4 | 244.4 | 282.7 |
| 12. | 3rd stage cooler, after | 136.2 | 135.5 | 96.5 | 104.0 | 118.0 | 136.7 |
| | SCAVENGE-AIR TEMPERATURES. FAH.° | | | | | | |
| 13. | Inlet | 41.0 | 41.1 | 41.7 | 41.9 | 41.0 | 47.6 |
| 14. | Outlet | 81.7 | 78.8 | 60.4 | 60.8 | 65.3 | 86.0 |
| | EXHAUST PRODUCTS TEMPERATURES. FAH.° | | | | | | |
| 15. | From Cylinder No. 1 | 417 | 554 | 244.9 | 306 | 356 | ..... |
| 16. | From Cylinder No. 2 | 481 | 581 | 251 | 311 | 346 | ..... |
| 17. | From Cylinder No. 3 | 449 | 473 | 221 | 293 | 378 | ..... |
| 18. | From Cylinder No. 4 | 485 | ... | 244.9 | 296 | 419 | ..... |
| 19. | Common Exhaust | 525 | 590 | 263 | 338 | 419 | 462.5 |
| | CIRCULATING-WATER TEMPERATURES. FAH.° | | | | | | |
| 20. | Common Inlet | 60.1 | 57.8 | 55.0 | 55.4 | 59.0 | 55.4 |
| 21. | Compressor Water Outlet | 74.7 | 72.0 | 64.0 | 65.0 | 69.0 | 71.1 |
| | OUTLET TEMPERATURE OF COOLING WATER FOR JACKETS OF POWER POWER CYLINDERS. FAH.° | | | | | | |
| 1. | No. 1 Cylinder | 104.5 | 109.4 | 89.6 | 97.7 | 103.1 | 105.0 |
| 2. | No. 2 Cylinder | 109.2 | 113.4 | 95.0 | 98.6 | 107.6 | 106.5 |
| 3. | No. 3 Cylinder | 109.6 | 108.5 | 96.8 | 102.2 | 110.3 | 100.7 |
| 4. | No. 4 Cylinder | 110.7 | 125.6 | 92.7 | 103.1 | 118.4 | 108.7 |
| 5. | Mean temperature outlets | 108.5 | 114.2 | 93.5 | 100.4 | 109.8 | 105.2 |
| 6. | Mean temperatures inlets | 60.1 | 57.8 | 55.0 | 55.4 | 59.0 | 55.4 |
| | OIL COOLER TEMPERATURES. | | | | | | |
| 7. | Water inlet | 61.7 | 58.6 | 55.4 | 55.4 | 58.9 | 57.6 |
| 8. | Water outlet | 73.4 | 72.5 | 69.2 | 67.0 | 68.5 | 80.5 |
| 9. | Oil inlet | 120.3 | 122.8 | 110.0 | 103.5 | 106.5 | 101.1 |
| 10. | Oil Outlet | 109.2 | 110.3 | 101.5 | 96.2 | 98.2 | 93.4 |
| | PISTON-COOLING OIL TEMPERATURES (OUTLET). | | | | | | |
| 11. | No. 1 Top Piston Outlet F.° | 144.7 | 147.0 | ..... | 114.0 | 124.0 | 135.0 |
| 12. | No. 1 Bottom Piston Outlet F.° | 138.7 | 143.0 | 115.0 | ..... | 123.0 | 113.9 |
| 13. | No. 2 Top Piston Outlet F.° | 138.7 | 142.7 | ..... | 114.8 | 120.2 | 122.1 |
| 14. | No. 2 Bottom Piston Outlet F.° | 139.6 | 140.9 | 117.8 | ..... | 140.9 | 115.6 |
| 15. | No. 3 Top Piston Outlet F.° | 146.1 | 153.5 | ..... | 116.2 | 128.3 | 129.2 |
| 16. | No. 3 Bottom Piston Outlet F.° | 138.1 | 136.5 | 115.7 | ..... | 119.5 | 115.3 |
| 17. | No. 4 Top Piston Outlet F.° | 139.1 | 144.2 | ..... | 114.0 | 122.0 | 129.3 |
| 18. | No. 4 Bottom Piston Outlet F.° | 139.6 | 146.5 | 118.0 | ..... | 123.0 | 117.5 |
| 19. | Mean Temperature | 140.4 | 144.6 | 116.6 | 114.7 | 125.1 | 122.2 |
| | QUANTITIES OF COOLING WATER AND COOLING OIL. | | | | | | |
| 20. | Power Cyls. jackets, lbs. per min. | 618 | 675 | 364 | 338 | 488 | 615 |
| 21. | Piston Cooling Oil per minute, pounds | ... | 328 | 248 | 316 | 389 | 378x |
| 22. | Air Comp. Jacket and Coolers, lbs. per min. | 282 | 284 | 280 | 256 | 300 | 323 |
| 23. | Oil Cooler Water, pounds per min | 362 | 366 | 355 | 320 | 357 | 345 |
| | x Estimated from previous test results. | | | | | | |
| 24. | Bearings Lubricating Oil per min., lbs | 114 | 130 | 102 | 113 | 115 | ... |
| | AIR COMPRESSOR—PRESSURE IN INTERCOOLERS—POUNDS PER SQUARE INCH. | | | | | | |
| 25. | Stage 1 | 36 | 36 | 37 | 37 | 37 | 32 |
| 26. | Stage 2 | 167 | 162 | 187 | 160 | 152 | 177 |
| 27. | Blast | 907 | 955 | 700 | 760 | 895 | 996 |

TESTS OF A CAMELLAIRD-FULLAGAR MARINE OIL ENGINE—SUMMARY OF POWERS, CONSUMPTIONS AND EFFICIENCIES.

| | | 1 | 4 | 5 | 6 | 7 | 9a | |
|---|---|---|---|---|---|---|---|---|
| 1. | Date of test | March 20th and March 21st, 1922 | | | | | | March 31, 1922 |
| 2. | Duration of test, in minutes | 375 | 36 | 49 | 28 | 19 | 180 | |
| 3. | Revolutions per minute (R) | 117.3 | 118.3 | 58.5 | 90.5 | 110.6 | 121.1 | |
| 4. | Mean effective pressure, power cyls., Lbs./sq. inch | 89.0 | 102.4 | 59.5 | 66.6 | 81.5 | 92.8 | |
| 5. | Brake mean effective pressure, power cyls., Lbs./sq. inch | 64.97 | 76.8 | 36.29 | 46.62 | 57.86 | 68.48 | |
| 6. | Power Cyls. (I.H.P.)p | 1420 | 1648 | 473 | 818 | 1220 | 1526 | |
| 7. | Scavenge Pumps (I.H.P.)s | 78.2 | 82.5 | 9.8 | .... | 59.5 | 87.6 | |
| 8. | Air Compressor (I.H.P.)c | 90.9 | 88.1 | 51.3 | 60.7 | 70.8 | 97.2 | |
| 9. | Brake load in pounds (L) | 3093 | 3653 | 1722 | 2210 | 2753 | 3254 | |
| 10. | Brake Horse Power | 1037 | 1235 | 288 | 571.4 | 870 | 1126 | B.H.P. = L R |
| 11. | Mechanical efficiency = B. H. P./(I.H.P.)p | 0.73 | 0.75 | 0.61 | 0.70 | 0.71 | 0.738 | 350 |
| 12. | Mechanical efficiency = B.H.P./(I.H.P.)p—(I.H.P.)c | 0.78 | 0.79 | 0.68 | 0.75 | 0.76 | 0.79 | |
| 13. | Mechanical efficiency = B.H.P./(I.H.P.)p—(I.H.P.)c—(I.H.P.)s | 0.83 | 0.83 | 0.70 | .... | 0.80 | 0.84 | |
| 14. | Weight of fuel oil used per hour., Lbs | 434 | 540 | 137.8 | 244.3 | 354 | 479.2 | |
| 15. | Weight of fuel oil used per B.H.P. hour., Lbs | 0.418 | 0.436 | 0.478 | 0.428 | 0.407 | 0.425 | |
| 16. | Weight of fuel oil used per (I.H.P.)p hour., Lbs | 0.305 | 0.327 | 0.290 | 0.298 | 0.290 | 0.314 | |
| 17. | Thermal efficiency | 0.462 | 0.431 | 0.486 | 0.473 | 0.486 | 0.444 | |

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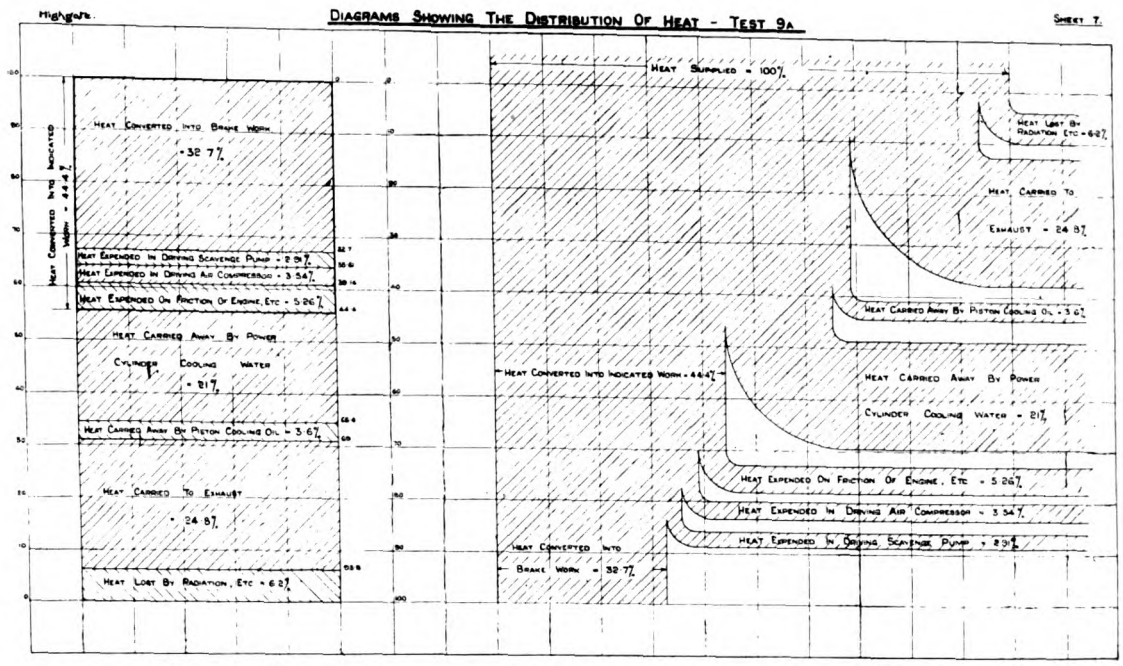
two tests with a similar object in view are likely to be identical. The more important thus becomes the system and magnitude of records to be taken during any series of tests by means of which the oil-engine designer will be in a position to draw deductions and arrive at conclusions the accuracy of which largely depends on his knowledge, his practical experience and his skill in collecting and analysing technical evidence.

Few will dispute Professor Watkinson's final remarks on the design and construction of the "Camellaird-Fullagar" engine and its future as a marine oil-engine. In fact that opinion has already found practical demonstration in the large number of constructional licenses which have been taken up by important engineering firms, five of which are situated in the British Isles, the remainder being distributed throughout the world, each important shipbuilding country, excepting the United States, having a license.


DIAGRAMS SHOWING THE DISTRIBUTION OF HEAT - TEST 9A
SHEET 7.
HEAT SUPPLIED = 100%
HEAT CONVERTED INTO BRAKE WORK = 32.7%
HEAT EXPENDED IN DRIVING SCAVENGE PUMP = 2.9%
HEAT EXPENDED IN DRIVING AIR COMPRESSOR = 3.54%
HEAT EXPENDED ON FRICTION OF ENGINE, ETC = 5.26%
HEAT CARRIED AWAY BY POWER CYLINDER COOLING WATER = 21%
HEAT CARRIED AWAY BY PISTON COOLING OIL = 3.6%
HEAT CARRIED TO EXHAUST = 24.8%
HEAT LOST BY RADIATION, ETC = 6.2%
HEAT CONVERTED INTO INDICATED WORK = 44.4%
HEAT CONVERTED INTO BRAKE WORK = 32.7%
HEAT LOST BY RADIATION ETC = 6.2%
HEAT CARRIED TO EXHAUST = 24.8%
HEAT CARRIED AWAY BY PISTON COOLING OIL = 3.6%
HEAT CARRIED AWAY BY POWER CYLINDER COOLING WATER = 21%
HEAT EXPENDED ON FRICTION OF ENGINE, ETC = 5.26%
HEAT EXPENDED IN DRIVING AIR COMPRESSOR = 3.54%
HEAT EXPENDED IN DRIVING SCAVENGE PUMP = 2.9%

**Sheet 7.—Diagrams showing the distribution of heat shown by Test No. 9A**

## OIL-ENGINED FISHING-TYPE YACHT FOR WORLD-CRUISE

AMONG the phases of the oil-engine industry covered by this magazine is that of pleasure craft, MOTORSHIP being in a position to give yacht-owners technical information on the engine-room lay-outs and on the operation of the machinery of their craft, unobtainable from any other source. But, we do not deal with gasoline-engined pleasure craft or gasoline-engined work-boats as not only are the same properly handled by magazines in the motor-boating field, but they are outside our scope.

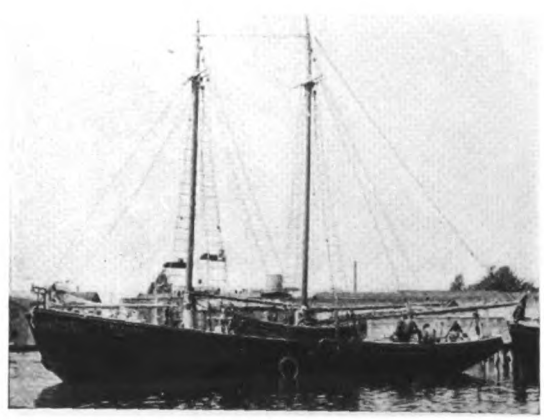
Our readers must have been impressed lately with the number of auxiliary oil-engined yachts which are being built, craft in which gasoline-engines have heretofore been almost universally installed. The yachting fleet is rapidly adopting oil-engine power. Among these craft is a "knockabout fisherman" schooner now building by James, one of the well-known builders of fishing vessels, at his yard in Essex, Mass., from designs by William H. Hand, Jr., of New Bedford, Mass. This schooner, one of the largest of this type ever built, will be completed during the Fall and will make a cruise around the world. She is of the following dimensions:

| | |
|---|---|
| Length over all | 139′ 0″ |
| Length water line | 107′ 0″ |
| Breadth | 26′ 0″ |
| Draft | 13′ 7″ |
| Displacement | 232 long tons |
| Sail area | 6,587 sq. ft. |
| Horse power, auxiliary engine | 100 |
| Make of engine | Bolinder |
| Speed under engine-power | 8 knots |
| Fuel capacity | 3,600 gals. |
| Cruising radius | 3,600 gals. (about) |

Her general design is typical of the fast seagoing fishing craft of the Grand Banks, the construction similar and the arrangement especially designed for safety and comfort at sea. The owner's quarters, consisting of a double stateroom with bath adjoining, are aft, while immediately forward is the engine-room between watertight bulkheads. This compartment is 19′-19″ long and contains a two-cylinder Bolinder new type reversible oil-engine and four fuel tanks holding 3,600 gallons, two lubricating-oil tanks carrying 600 gallons and two fresh water tanks holding 1,600 gallons, additional water-tanks being provided under the cabin floor.

An idea of the exceptionally rugged construction will be gained from her scantlings, the keel being of white oak sided 14″, the keelson built-up of five strakes of 4″ by 12″ Georgia pine, the frames are sided 7″ double-moulded, making total siding 14″ spaced 24″ centres. Planking is 3″ white oak, ceiling 4″ Georgia pine and the deck is 3″ teak, which is best for service in warm climates, in which the vessel will cruise for some time. Unlike the usual yacht construction, the planking will be fastened by treenails extending through frames and ceiling as per ship practice. The ceiling is fastened with headed bolts. To secure proper action at sea all ballast will be inside, the space below the top of the keelson being filled with cement and boiler-punchings and pig iron stowed above this.

Her cabin equipment incorporates several interesting features. Of course she has a Shipmate stove and there is also a small heater to provide steam-heat for the whole boat. In order to prevent fumes from the storage-batteries, which, by the way, weigh over two tons, entering the quarters they are located on deck in a specially constructed ventilated compartment. The deck-house over the engine is removable and in case of emergency the main boom of the yacht can be used to hoist out the engine without outside aid. Electric-lights and refrigerated-stores will be provided and every feature incorporated which would lead to safety and comfort on such a voyage.



**The "Lincoln," Wolverine-powered swordfishing schooner**

## AN ECONOMICAL SWORDFISHERMAN

One of the picturesque features of the New England fishing fleet is the sword-fishing vessel with its "pulpit" at the bow in which one of the crew stands with a long, sharp spear attached to a line. As the swordfish is sighted passing under the bows this spear is plunged into it, which usually results in adding from two to seven hundred pounds to the cargo in the hold. These swordfishermen often cruise off the coast in search of their catch for three or four weeks, usually sailing, but an economical auxiliary engine is necessary. In this field the oil-engine is rapidly gaining favor, one of the latest craft to be equipped being the LINCOLN, owned by Capt. Joe Rocha, of New Bedford, Mass., which now has a four-cylinder 95 h.p. Wolverine oil-engine installed.

This schooner is 72 ft. long, 17 ft. breadth and 7 ft. 6 in. draft and our illustration indicates that she formerly carried topmasts for topsails which are set in light winds. As all additional light weather sails require more crew to handle them the tendency is to replace them by engine power. The economy of the oil-engine is so great that it approaches that of sail-power greater than is possible in any other engine. On a recent four-weeks trip to the fishing banks the total expense for all fuel and lubricating oil was only $140, which cost was entirely wiped out by the sale of but a few swordfish of her profitable catch.

## A BOLINDER-ENGINED COASTER

Hepples, Ltd., of South Shields, England, recently built a motor-coaster, the ARRAN FIRTH. She is a steel vessel 138′ 6″ length, 23′ 3″ breadth and carries 380 tons cargo at an average speed in loaded condition of 9 knots on a consumption of 1¼ to 1½ tons per day. As she carries 21 tons of fuel-oil her 350 b.h.p. Bolinder surface-ignition oil-engine can operate for 14 days continuous running. The propelling machinery is installed aft, while forward of this is the cargo-hold with hatches served by two 34 ft. derricks and electric winches. An electric-windlass is also installed.

## BUYS BOLINDER ENGINES

Two 320 b.h.p. Bolinder surface-ignition oil-engines have been purchased by the Carey-Davis Towing Co., of Seattle, Wash., from the U. S. Shipping Board Emergency Fleet Corp. They will be installed in tugs.

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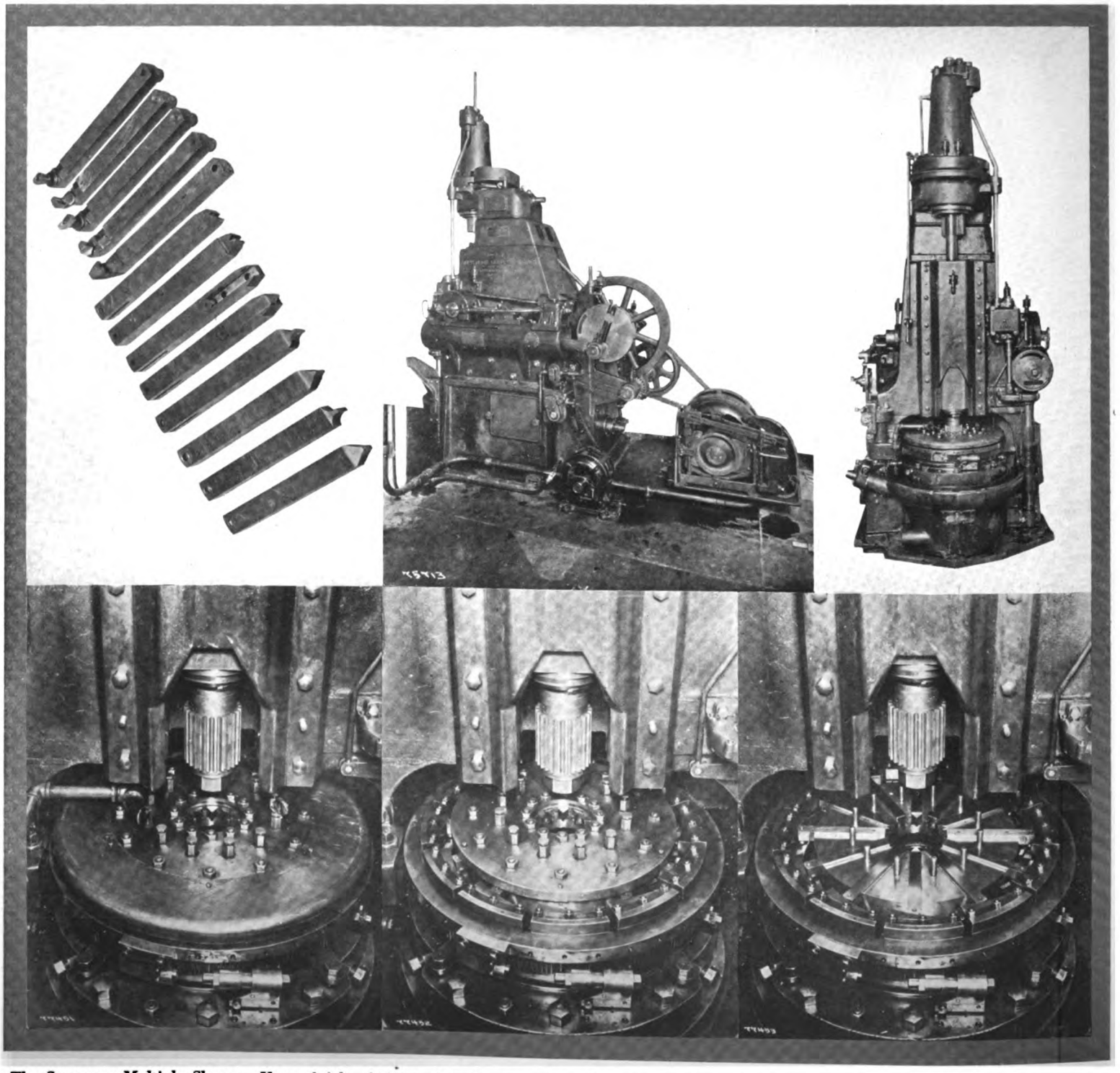
# A Remarkable Gear-Cutting Machine

***The Stevenson Multiple Shaper Should Interest Manufacturers of Diesel and Oil-Engines***

CONSIDERABLE gear-cutting enters into the manufacture of Diesel-engines, therefore, we believe that the Stevenson Multiple Shaper will be of interest to those of our readers engaged in this work. This machine possesses so many valuable features which are not found in the usual machine that they are worthy of mention. Built in both up-stroke and down-stroke models it operates in the same manner as the usual vertical shaper, except that the tools are held stationary and the gear blanks are reciprocated past the tools. The principal unit of mechanism is a special tool head which consists essentially of a series of radially disposed tools spaced about the circumference of the blank to be cut. A ram carries a blank supporting arbor, a multiple tooled head for operating on the blank is mounted stationary on the main frame of the machine, there is a feed mechanism for feeding the tools into the desired depth gradually to take successive cuts in the same way as a shaper and an indexing mechanism for indexing the gear being cut, a space equal to one tooth at every stroke of the ram.

Each type possesses certain advantages for certain types of work, these arising from the fact that the work arbor is changed at the completion of each arbor full of gears. The operation of changing the work arbor instead of removing the gears from the arbor and leaving the same arbor in the machine all the time is an exclusive feature of the Stevenson machine. It is possible to follow this procedure because unlike gear-cutters using an unhardened spindle and frequently an unhardened arbor, the Stevenson machine is provided with a hardened and ground spindle and arbor and can be quickly and accurately removed and replaced. Where these parts are unhardened it is impossible to do this many times with continuous accuracy. In the average shaper the cutting process is many times longer than in the Stevenson machine, too long in proportion to the time required to remove cut gears from the arbor and replace them with uncut blanks; where the average time for cutting the average arbor of gears is one to two minutes in the Stevenson machine it is essential that every second be spent in productive work and non-productive work, such as changing blanks, be reduced to a minimum. Therefore, the design of the whole machine has been based on this quick and accurate change of gear blanks, resulting in a saving in time of 50 to 80 per cent. over machines of the other type.

Considered from the standpoint of production on these machines gears may be divided into two classes, those cut on their largest diameter and those having teeth cut on a smaller diameter. The former includes the general run of plain external spur gears which are stacked on an arbor, two to ten in number according to thickness while the latter class includes internal gears, internal splines, external cluster gears and gears in which the teeth terminate near a shoulder. External gears constitute about 80 per cent. of the total number of gears used and can be passed through the



**The Stevenson Multiple Shaper. Upper left-hand illustration shows cutting-tools; upper center and right, views of the machine; lower illustrations show the construction of the multiple-tool head**

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tool head of this multiple shaper when the tools are withdrawn from the cutting position. Internal gears cannot be passed through the tool head because some other part of the gear is larger than the part on which the teeth are cut and consequently the tools cannot ordinarily be withdrawn sufficiently to allow the gear to pass through. Therefore, the up-stroke shaper is adapted to the plain external gears which can be passed through the tool head and the down-stroke type is used for internal gears, cluster gears, etc.

In the up-stroke type the operation of changing arbors consists merely of stopping the machine, kicking out the arbor by means of a foot pedal and dropping another arbor in place through the tool head, while in the down-stroke machine this operation is performed by stopping the machine and elevating the ram to provide extra working clearance so that the arbor may be dropped down and removed. The new arbor is then placed in the spindle, fastened in place, the ram lowered and the machine started, requiring about one-half a minute longer to change arbors in the down-stroke than in the up-stroke machine.

A machine of the multiple shaper type possesses many advantages over the one-tooth machine in addition to the increased production as the tools being arranged completely around the circumference of the gear blank and all cutting simultaneously the gear blank is held central, whereas one tool working alone has a tendency to spring the arbor slightly and cause the gear to be eccentric. With this multiple shaper the blank cannot spring away from the cutting tool. Also, gears of different materials can be cut at the same time all stacked on the same arbor, so that laminated gears composed of various materials such as steel, brass, raw-hide, cast-iron, fibre, bronze, etc., can be cut at once. On the average machine, owing to the difference in hardness and toughness of the various materials the tool springs away from the blank a different amount for each material. This shaper is suited to the production of all cylindrical products having teeth or grooves such as sprockets, splined shafts, reamers, taps, milling cutters and saws, ratchets and knitting machine rolls.

This machine is capable of the closest and most accurate adjustment possible and in spite of the speed of production each tooth is most accurately cut. Mistakes on the part of the operator are guarded against; in order to set the ram and work in proper relative vertical position to the tools a stationary pointer is attached to the machine frame and a corresponding mark is placed on the crank-head in such an angular position with reference to the crank-pin that when the mark on the crank-head is set opposite to the pointer the ram may be adjusted downward until the lower side of the blanks is even with the cutting edge of the tools. The elevating control stops are then set to correspond to this position and require no further attention from the operator, which is a convenience and also eliminates mistakes in setting up the work.

The entire cycle of motions which composes the tooth-cutting operation is automatic, giving the operator opportunity to place blanks on another arbor while the machine is cutting, thus saving considerable time. When the cutting operation has been completed the machine is stopped by the operator by means of a push button switch which operates an electric brake. Finally we will mention that the maker of this tool is the Stevenson Gear Co., Indianapolis, Ind.

# New Pacific Coast Diesel-Electric Yacht "Valero II"

## *Another Winton-Westinghouse Installation*

A DIESEL-ELECTRIC yacht of luxurious appointments, but above all things a practical boat built for sturdy service and designed by the owner himself, a yachtsman of more than twenty years' experience, is the VALERO II, owned by G. Allan Hancock of Los Angeles, which was put in commission October 28 from the yard of William Muller in Long Beach, Cal. The yacht arrived at San Francisco November 3 on the trial trip, and left for Southern California again four days later to undergo numerous finishing touches which are expected to take about two months.

Two six-cylinder Winton Diesel-engines of 110 b.h.p., each driving a Westinghouse electric generating-plant, constitute the propelling machinery. The VALERO II is 125 feet in length overall, with 20 ft. breadth, is of 220 tons gross and has a speed of 10½ knots. Her cost was $400,000. The hull is of solid mahogany, with mahogany fittings throughout, except for the wireless room and after companionway, where primavera wood, or "white mahogany," as it is sometimes called, is used. It is marked by unusually strong construction, as there are three keelsons, double planking inside and outside the frames, four bilge clamps and more than double the usual number of bolts.

Captain Hancock, who is master of his own vessel, will conduct a trade investigation trip early in 1923 for the Los Angeles Chamber of Commerce down the west coast of Mexico and Central America, visiting as many ports as possible, and probably going through the Panama Canal and up to New Orleans as a pleasure feature of the voyage.

Captain Hancock believes his new yacht is cheaper to operate than an automobile from a fuel aspect, as he found on his trial trip that the oil used only cost about 30 cents an hour, while, in his opinion, an automobile costs 60 cents.

The engine-room of the VALERO II is compact, but nevertheless a roomy and well-lighted compartment. The rear bulkhead is lined with tools in a neat and handy arrangement above a work-bench equipped with a power lathe, emery wheel and drill press. The control platform is at the forward end, with the motor and main generator sets underneath, while the starting air-bottles lie horizontally against the ceiling on the port side. The pneumatic water supply system is in the forward port corner and the fuel-service pump and day tank in the corresponding starboard corner, the bilge pump and motor gasoline generator and auxiliary switchboard in the aft starboard corner, and the auxiliary air-compressor in the aft port corner.

Because Diesel-electric drive is used, no air is needed for reversing, and as only a small amount of air is used for starting, the initial charge of air in the two 1,000 lbs. high-pressure bottles and the 600 lbs. low-pressure bottle were practically all that were required in the first two weeks of operation. A new type of air-compressor valve was installed by the Winton Company on the engines. The latter are equipped with governors of Winton design.

This yacht has both pilot-house and engine-room control, the latter being used only for emergencies. The two Westinghouse generator-sets are used in series and hooked up together as one unit, developing 220 horsepower; but in case of necessity can be separated and run as individual sets. The motor lies between them. The Westinghouse exciters are direct connected on the end of the shaft, being large enough (nine kilowatts each) so that one can be used for exciting, leaving the other for auxiliary power on the shaft. The main motor drives a propeller of 5 ft. diameter by 4 ft. 2 in. pitch. The control board is insulated, has a circuit breaker which can be reset electrically from the pilot-house or by hand from the board, and the generators are connected by solid tape-covered bus-bars instead of by wires, so that it is possible to walk behind the board without shock. This use of bars is a new feature for which T. P. Laughlin, assistant to William Muller, is responsible. The bus-bars are supported on porcelain insulators.

The two fuel-tanks, located just forward of the engine-room, have a combined capacity of 7,000 gallons. The day-tank holds 125 gallons and is fed by a Kinney fuel-service pump. A six-cylinder Winton gasoline motor drives a 7½ horse-power Westinghouse motor for auxiliary lighting purposes. All the other engine-room motors are Westinghouse. The pneumatic water supply system is a Fairbanks-Morse product, filling a 125-gallon capacity tank. Heating of the various compartments is by seven 1,000 volt Westinghouse heaters. Underneath the deck plates of the engine-room are 56 Exide iron-clad storage batteries, 60 ampere capacity, 112 volt, connected in series. The length of the engine-room is 27 ft. and the machinery weighs 40 tons. The pilot-house contains a control board with the same number of meters as in the engine-room.

Back of the forecastle is the galley, with a Shipmate range with Norway kerosene burner, and with an Ilg. blower ventilating this room and the forecastle. The main ventilating system is an Ilg., driven by a two horse-power variable speed Westinghouse motor furnishing 3,800 cubic feet of air a minute. A large ice-machine, ice box and a storeroom where canned goods and other staples are kept on large rack-like shelves with removable front slats are also in this section of the boat.

Deck equipment includes two Welin quadrant davits shortened to fit the height of the yacht, a Lietz rotary-brake sounding-machine reaching 270 fathoms, a Mead-Morrison winch driven by a six horse-power Westinghouse motor, a Hyde anchor-winch driven by a 7½ horse-power General Electric motor, a 20-foot launch with a Union gasoline motor and a motor-driven lifeboat, also with a Union engine.

### SIR CHARLES PARSONS AND INTERNAL-COMBUSTION TURBINE

In a recent lecture Sir Charles Parsons of turbine fame indicated that there was a flaw in the reasoning that the gas-turbine should supersede the gas-engine because the steam-turbine has largely superseded the reciprocating steam-engine. His argument is that the steam engine and steam turbine work between limits of temperature which metals will stand without melting or serious oxidation, whereas the gas engine and gas turbine have to deal with a working fluid far above the melting points of the metals of which they are constructed. Further, in the steam engine and steam turbine the metal is nearly at the same temperature as the working substance, whereas in the gas-engine and gas-turbine the metal must be kept at a much lower temperature than the working substance, else it would melt. There seemed to him to be little question but that as regards durability and efficiency the piston is much superior to the gas turbine as a means of expanding hot gases and abstracting their energy.

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# Our Readers' Opinion

*(The publication of letters does not necessarily imply Editorial endorsement of opinions expressed)*

### THE ENGINE-ROOM PERSONNEL PROBLEM

To the Editor of Motorship:

If you will grant me a little space I would like to put in a few words in defence of a class of men who have done a great deal for the success of the Diesel-engine on the Pacific Coast and are receiving no credit for it. The men I refer to are the much-maligned "gas-skinners." With so many articles appearing in engineering periodicals in regard to training steam engineers to operate Diesel-engines I think some attention should be directed toward the gas-engineer as possible material for a first-class Diesel operator. All argument to the contrary notwithstanding, the fact remains that much of the knowledge gained through years of gas-engine operation is decidedly useful in Diesel operation.

As I see it the only advantage to be gained by training a steam-engineer in preference to a gas-engineer are as follows—the average steam-engineer is more accustomed to large ships and large pieces of machinery than the average gas-engineer, the proportion of men who "served their time" at the machinists' trade is greater among the steam engineers, and the steam-engineer has generally been required to have slightly more theoretical knowledge than the gas man, consequently is more easily induced to study up on theory. The steam man knows that he needs special training before he can successfully operate a Diesel or obtain a license to do so, whereas many gas men think that because their licenses cover large motorships, they are competent to run them without any more training or study.

The advantages to be gained in training *experienced* and *intelligent* gas-engineers to operate Diesels are as follows: The smaller Diesel engines and some of the fairly large ones are very similar in mechanical construction to gas-engines, many of the problems arising in the operation of a Diesel-engine are identical with gas-engine practice (to go into detail here would show a surprising similarity). Many gas-engineers were full-fledged machinists before becoming engineers, many of them are as well "up" on the gas engine theory as any steam man is on steam-engineering theory, most gas-engineers have a deeper knowledge of electricity than is required of an average steam man. This should be useful in view of the almost universal practice of installing electric auxiliaries on modern motorships.

During the past year there have been a great many small "airless-injection" Diesel engines installed in Pacific Coast work-boats, and at present there are a great many being installed. The advertisements and magazine articles almost invariably state that these engines are being operated by inexperienced men or imply that the engines are practically running themselves. Now, I don't wish to say anything against the engines, they are fine pieces of machinery and are performing wonderfully and saving their owners lots of money; but they are not running themselves and are not being run by inexperienced men. They are being run by former gas-engineers—many of whom were expert engineers and veritable wizards with gas engines before they started running Diesels. This, it seems to me, demonstrates that some gas-engineers are able to handle at least small Diesels as well as they handled gas-engines. So if Diesel-engineers for large plants are needed, why not experiment by training some of these boys.

During the war, when so many wooden auxiliaries were built and had to have men with motor licenses, lots of these "gas-skinners" went out on them and made good. And many of the wooden auxiliaries that were failures, were not so entirely on account of the engine-room personnel.

Hoping this viewpoint will be of some real benefit, and will prove offensive to no one.

Joe. E. Merrill.

Oakland, Cal.

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To the Editor of Motorship:

When steamship operators first ventured into the Diesel game they looked for the man who had "Diesel Expert" painted on his shingle, irrespective of ability and sea experience, which became a very bitter pill for the operators. It, however, went along without a murmur until the competition became keener, and retrenchment and economy became a necessity if they were to remain in the game. It was then the question arose, how to reduce operating expenses, which resulted in some cases in the removal of the Diesel engines, and in some cases of the Diesel expert. It was a hard blow to motorship building in general

In my experience, both on ships and ashore, I have found in all walks of life and in all trades and professions two distinct classes of men, one who accomplishes something and gives results, the other who works his chin criticizing and lamenting, and whose great pastime it is to pass judgment on everybody and everything around him, wthout making any attempt to improve the situation.

We have in our country some of the most brilliant and successful marine engineers in the world, and who could measure up to any occasion demanded of them. I admit that the marine engineer's profession was polluted during the war, not intentionally but as a war emergency, and the tarnished spot is getting brighter as we go along, "The survival of the fittest," as it were.

Therefore, when we speak of a marine engineer, let us understand that he is a mechanic with machine-shop experience, and has sailed a few years on board of ocean-going ships on his license, which has not only made him proficient in his calling as an engineer, but also a disciplinarian and a gentleman, knowing routine work at sea, and able to act on his own initiative when the emergency arises.

Such men with the theory of internal-combustion and ambition enough to take pride in their work will and can operate motorships. Consequently there should be no worry for shipbuilders or operators from that source, as any intelligent marine-engineer when assuming charge of a power plant, "if of the reciprocating kind," will upon first opportunity apply the indicator, and take a photograph, as it were, of the interior workings of his engines, to satisfy himself that the mean-effective pressure, as well as all adjustments, are correct. This is of the utmost importance with a Diesel engine and its compressors, owing to the high pressures and correspondingly high temperatures.

And in conclusion I wish to suggest that when an engineer has been selected for a position on a motorship under construction that he be given an opportunity to stand by and watch some of the installation work, in order to thoroughly familiarize himself with the machinery, so as to have a mental sketch of the whole plant. I am therefore safe to say that the cost of his time will be paid back to the owners with compound interest when the ship is commissioned. Oscar Olson,

Ex-Chief-Engineer M/S William Penn.

[Mr. Olson has left the Wm. Penn to take a position on shore.—*Editor.*]

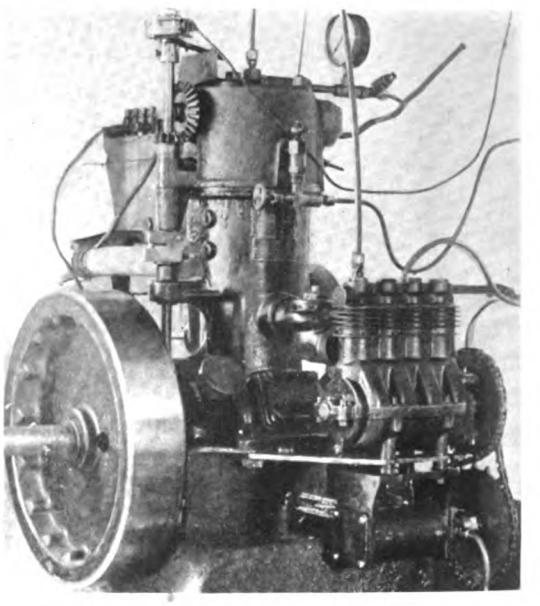
### FUEL-INJECTION AT HIGH REVOLUTION SPEED

To the Editor of Motorship:

I note in your October issue an article anent heavy oil-engine for use in airships, and some difficulties encountered with high-speed fuel injection. In this connection it might be of interest to some of your readers to note that some time ago I developed a high-speed fuel injector which I fitted to the small two-cycle marine engine shown in the attached illustration with which I secured perfect firing and clean exhaust at over 1,800 r.p.m. on gas-oil. I am satisfied that this was by no means the limit for the injector, but the engine was rated at 800 r.p.m. and the heavy piston, low ports, etc., did not permit of very fast operation.

I employed air injection at about 120 lbs. pressure, with about 100 lbs. cylinder compression, starting with a high-tension spark and running with surface ignition. Injection fuel between 60 deg. and 90 deg. before top center gave me the best results.

Air was supplied by a small single stage air-cooled compressor (which showed no signs of distress), and measured to the injector by a small rotary-valve running at half crankshaft speed. Fuel was fed by a rotary pump of my own design at about 120 lbs. pressure, the



supply to the engine being regulated by a needle valve, and the surplus by-passed back to the tank. The fuel and air feeding mechanism gave me practically no trouble, and I believe that I was well on the way to a solution of atomizer and combustion chamber design which would avoid detonation and provide all the necessary flexibility of operation.

While I lacked any accurate means for testing the engine it showed very good power and torque even at slow speed considering its size (4⅛" x 4"). It also ran well on old crankcase oil, and on creosote oil. Owing to the exigencies of earning a living in a community where interest in oil engines is scant, to say the most, I have had to forego further development for the present. The fundamental features of the injection system are covered by U. S. Patent No. 1,244,733, issued to the writer. I shall be pleased to furnish anyone interested with any further information in my possession. Henry B. Higgins, Jr.

1345 Forest Street, Denver, Col.

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### STEAMSHIP ENGINEERS ARE INTERESTED

To the Editor of Motorship:

Having become greatly interested in Diesel engines on land as well as at sea, I am prompted to subscribe to your magazine Motorship. I am also interested in your publication, the 1922 Motorship Yearbook.

Edward T. Senter,

Chief Engineer Steamship Solana, Pacific Mail Steamship Co., Canal Zone.

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(*Continued from page 921*)

figuring the fuel economy on the basis of a twenty-hour round trip per day. Contract for machinery was awarded to the Enterprise Engine Company for their airless-injection type of Diesel engine that operates by forcing the fuel by what is known as airless or solid-injection through the nozzles into the cylinders at 4,000 pounds' pressure.

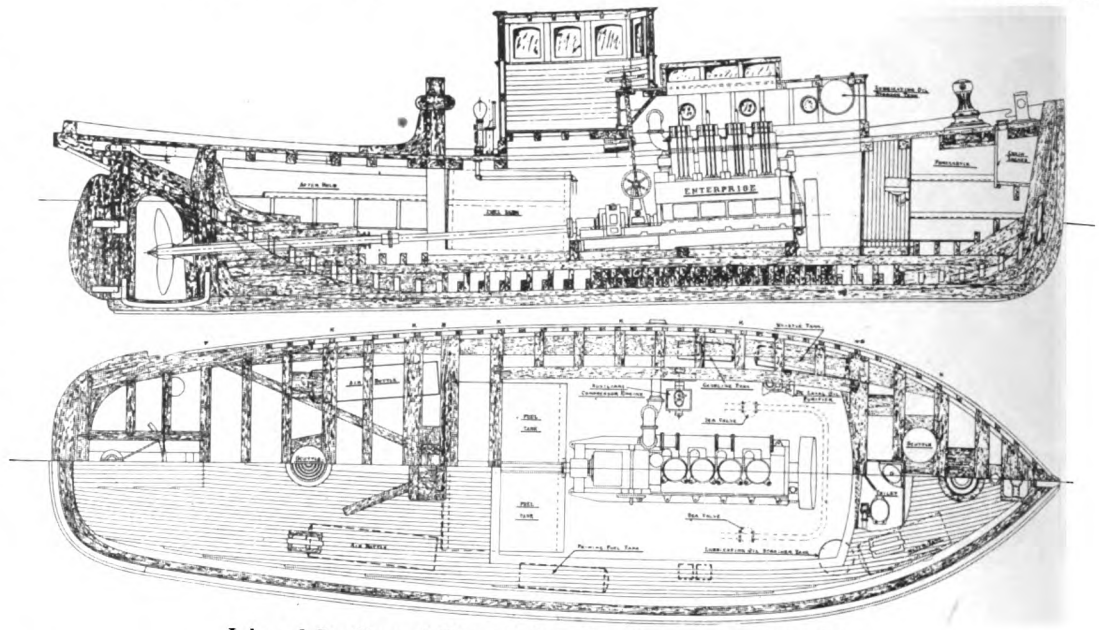
This engine is rated 165 horsepower, with 4 cylinders 10½" diam. and 14" stroke, turning 320 revolutions per minute.

The fuel used is what is known commercially on the Pacific coast as Diesel fuel oil of 24 degrees Baumé, the characteristics being as follows:

| | |
|---|---|
| Baumé | 24° |
| Specific gravity | 0.9091 |
| Pounds per U. S. gallon | 7.571 |
| Ash (passes 200 mesh) | 0.037% |
| Asphalt (residue steam-distillation by weight) | 3.41 % |
| Sulphur | 0.45 % |
| British thermal units per pound | 18916 |
| British thermal units per gallon | 143213 |

The Diesel fuel-oil is used at 60 degrees Fahrenheit and has a viscosity of 122 seconds Saybolt Meter. In order to determine whether it would be possible to run the boat on ordinary steamer-fuel an experiment was performed by heating the steamer-fuel to 140° Fahrenheit, whereby the viscosity was reduced below that of 24° Baumé fuel-oil so it would pass through the eight to twelve thousandths holes in the nozzles of the high-pressure engine. Mr. Dickie found from a careful trial that there is some other factor to be taken into account as the heated fuel refuses to flow indefinitely at 140° Fahrenheit. It seems to form a sticky gum in the nozzle which finally closes the small holes. Further experiments are contemplated.

A further improvement was introduced into the lubricating-oil system. It is force-fed throughout and the waste-oil that returns to the sump is removed from the system and passed through a De Laval oil purifier to be cleaned, and from there passed to the cooler-tank. Ordinarily the oil is taken from the sump, run through a cooler in the circulating-water system and back to the cooler-tank. The fresh oil is taken from the storage tank to replenish the oiling system. The temperature of the lubricating oil rises to 134 degrees Fahrenheit after a hard run. The amount of lubricating oil recovered by this machine pays for the entire cost of the machine in a short while and leaves a handsome profit for the owner. The electrical work on this new tug was done by Ets-Hokin & Galvan, and the fuel tanks were furnished by the California Steel Products Company.




**Inboard Profile and Plan of Coos Bay Lumber Co. Diesel-Tug**

# Diesel-Engines in San Francisco Trawlers

***Performances Induce Owners to Install Additional Atlas-Imperial Diesel-Engines in Craft of Their Fleet***

SINCE the W. C. F. Co. No. 2 went into service early in October, the economy and reliability have been so marked that her owners, the Western California Fish Co., of San Francisco, decided to construct a duplicate of this craft and to convert their 75 ft. trawler PEDRO COSTA from steam to similar Diesel-power. Conversion of this boat will give this company four Atlas-Imperial Diesel-engined craft, as the W. C. F. Co. No. 1 recently had a 90 h.p. Diesel-engine installed in place of her 80 h.p. distillate-engine.

This new trawler, W. C. F. Co. No. 2, was built by W. F. Stone & Son, Oakland, Cal., and is of the following dimensions:

| | |
|---|---|
| Length (o. a.) | 64 ft., 6 in. |
| Breadth (m.d.) | 16 ft. |
| Draft | 7 ft., 4 in. |
| Power | 125 b.h.p. |

She is the first Diesel-trawler operating out of San Francisco which has been newly constructed for Diesel-power, as the W. C. F. No. 1, and three other Diesel-trawlers owned by the Independent, San Francisco International, and Paladini fishing companies were all originally equipped with either distillate or steam engines and were converted to Diesel-power.

The Diesel-engines in these trawlers are operating almost constantly, as the fishing fleet starts out daily, except Saturday, at 3 a. m., regardless of weather conditions, and cruises as far as 60 miles from the Golden Gate, returning between 6 p. m. and 10 p. m. As the Captain and the "boss-fisherman" alternate in acting as engineer, the engine is controlled by levers carried to the pilot house and the services of a man in the engine-room are eliminated. Another feature in the apparatus is the use of double-drums on the winch equipment, making possible the saving of about twenty minutes on each drag.

About 1,000 gallons of fuel-oil in three tanks are provided in the engine-room so that the boat has a long radius of action without refueling. Her speed is 10½ knots. The crew consists of Captain, "boss-fisherman," and six men. Two water-tight bulk-heads at either end of the engine-room, which is 20 ft. long, divide the boat into three compartments. Unusually heavy timbers are provided through the construction of this boat, making her as sturdy as can be built.

As an example of the reduced cost of operating a trawler with Diesel-engines, the Western California Fish Company found the fuel cost for the "No. 2" for a given period to be $21.39, while in the same length of time an 80 h.p. distillate-engined boat cost $202 to operate. In 152 hours the "No. 2" burned 690 gallons of fuel oil, less than four gallons an hour, and used less than one gallon of lubricating-oil in ten hours, a record that surpassed the Atlas-Imperial Engine Company's guarantee.

**New Atlas-Imperial Diesel-engined trawler "W. C. F. No. 2"**

### RECORD CARGO FOR MOTORSHIP THROUGH PANAMA CANAL

The Danish motorship AFRIKA of the East Asiatic Co., passing through the Canal on October 19 on her way from Vancouver and San Francisco to Copenhagen via St. Thomas, was carrying a general cargo aggregating 10,200 tons, which is believed to be a record cargo through the canal on a motorship, to date. The cargo declaration reported 5,200 tons of barley, shipped from San Francisco to London and Hull; 2,000 tons of canned fruit, from San Francisco to various ports; and 3,000 tons of wool, from Vancouver, Portland, and Seattle to Rotterdam, London, and Hull.

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